Motorship

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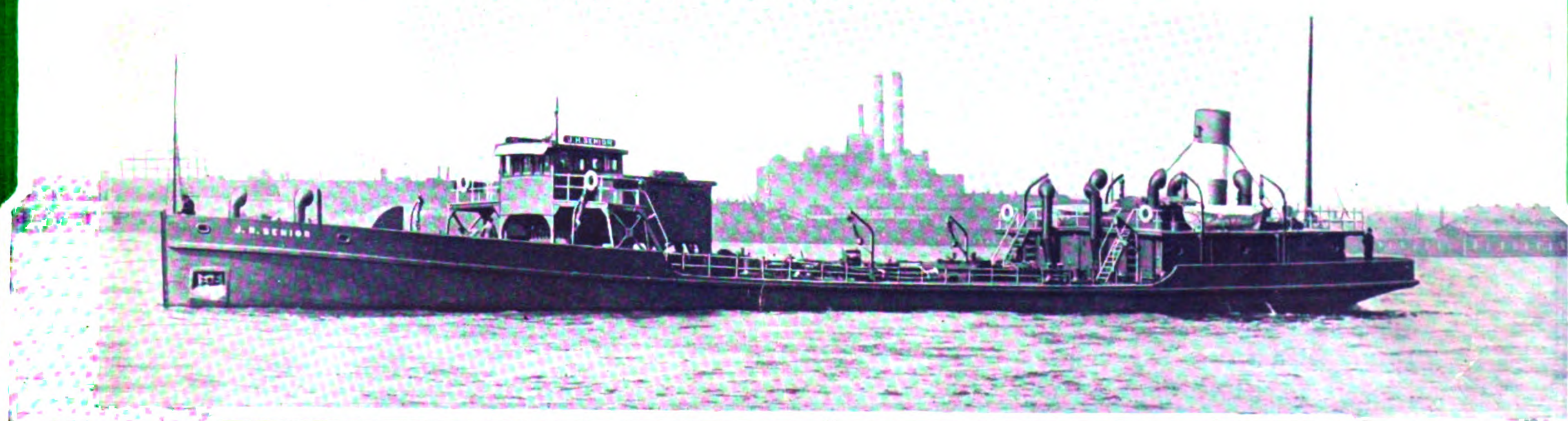

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Motorship

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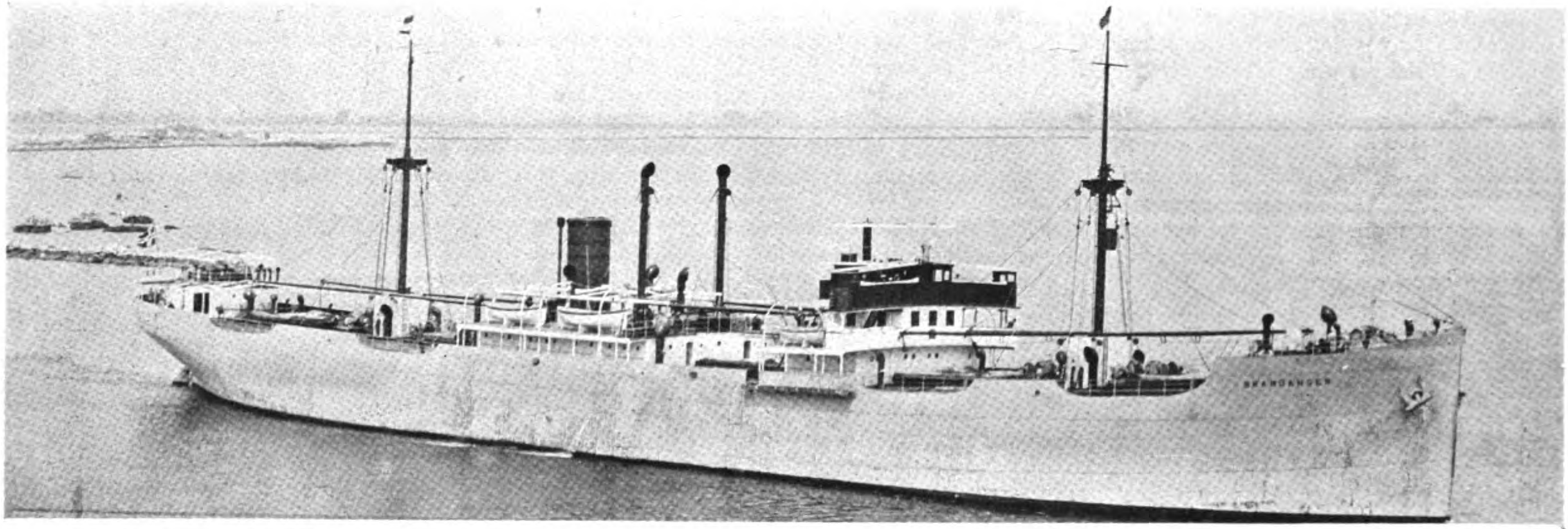
Why the Motorship is a Conserver of Fuel And a Saver of Shipowners' Money

This Article Contains a Thorough Interpretation of the Motorship Attribute—Economy in the Fuel Item—in Actual Figures. It Shows the Relation Between Consumption and Speed

WHEN we read the published statement of a high official of a shipowning company operating one big motor passenger liner and several steam driven passenger liners, that the motor passenger liner—6,000 tons larger than one of the steamers—costs $10,000 less per round trip to operate than the steamer, it is evident that there is a superiority about the Diesel engined ship of which no shipowner can afford to refuse cognizance. Furthermore, so delighted have the owners of this ship—the Swedish America Liner GRIPSHOLM—been that they have ordered two further ships, one of the same size and one larger.

The basic superiorities of the motorship have been recited and repeated almost *ad nauseum*. Nevertheless, there appears to exist, even today, when motorship tonnage building exceeds steamship tonnage, an unnecessary amount of misconception and ignorance as to the real potentialities of the motorship. How far misconception is tempered with prejudice, and ignorance with apathy, it is difficult to say. The motorship owes its success to one factor and one factor alone—its economy of operation. The shipowner is not interested primarily in the type of prime mover which propels his ship. He wants the prime mover which will save him the largest aggregate of dollars and cents per round trip. A total of $10,000 mentioned above is surely a potent factor in this direction. In 10 round trips per year, which this motorship ordinarily makes, the $100,000 per annum more than offsets the extra first cost of the vessel. The total fuel consumption for all purposes works out at about 58 tons per 24 hours. The motorship costs initially somewhat more than the steamer. Diesel fuel oil is an expensive type of marine fuel. Where then, getting down to fundamentals, is the saving effected?

An analysis of performances of existant motorships will show something of this. Their fuel consumptions in relation to their types of engines and layouts of engines will reveal much important data. Unfortunately there is a great difficulty in obtaining reliable performance figures from companies who operate motorships. Shipowners are perhaps naturally secretive, and especially so today when competition is severe. The engine builder can often be helpful, however, by making special demands on the shipowner. It is perhaps significant that the engine building company which has published more information about the particular type of 4-cycle engines it makes than all the other engine builders put together, has on the high seas at the time of writing an aggregate horsepower well in excess of the aggregates of other makers. There may, or may not, be any connection between these two facts.



The 8350 tons dw. 2800 hp. Ms. Brandanger uses 9 tons of oil per day, while a corresponding oil burning steamer consumes about 22 tons. She beats steamer time by 5 days between Los Angeles and Buenos Aires via Magellan

As a preliminary excursion into the realms of motorship economy, consider two ships, one a motorship of 8,000 tons dw., the other a "Monitor" type coal burning steamer. The steamer's special corrugated hull structure cuts her fuel bill and generally secures good conditions for propulsive efficiency. The motorship has a length b.p. of 380 ft. and makes 11 knots on 8 tons of fuel for 24 hours, for all purposes developing 2,600 i.hp. The steamer has a length b.p. of 390 ft. and makes 10½ knots on 23 tons of fuel for 24 hours for all purposes. In other words, she uses just about 3 times the amount of fuel per day that the motorship uses. This fuel, moreover, the steamer carries in side and cross bunkers, which to the motorship are potential freight carrying space. The motorship's operating radius is about 3 times that of the steamer.

TABLE A—Typical Motorship Fuel Consumptions with Corresponding Engine Data

No.	Type	Size	Service	Cycle	Power	Unit No. of Cyls.	R.P.M.	Fuel 24 Hrs.	Action	Speed	Construction	No. of Shafts	Remarks
1.	Pass. Liner	17,491 G.	Transatlantic	4	13,750 S	6	125	*58*	Double	17	Crosshead	2	All purposes
2.	Pass. Liner	17,300 G.	Transpacific	2	13,000 S	6	127	*55*	Single	16.4	Crosshead	4	125 gal. lub. oil/24 hrs.
3.	Freighter	15,000 D.W.	L'pool-Australia	4	9,000 I	8	111	*26.5*	Single	14	Crosshead	2	All purposes
4.	"Pacific Coaster"	10,000 D.W.	U. K.-Pac. Coast	4	4,200 I	8	115	*20.0*	Single	13.5	Crosshead	2	All purposes
5.	Freighter	10,500 D.W.	Transpacific	2	3,400 S	4	100	*14.8*	Single	11.5	Crosshead	2	16.7 gal. lub. oil/24 hrs.
6.	Freighter	10,500 D.W.	Transpacific	4	3,400 S	8	124	*14.8*	Single	11.5	Crosshead	2	14.0 gal. lub. oil/24 hrs.
7.	Freighter	8,100 D.W.	Transpacific	2[1]	1,760 S	3	90	*7.8*	O. P.	11	O. P.	1	14.3 gal. lub. oil/24 hrs.
8.	Freighter	8,000 D.W.	L'pool-D. E. Indies	2[2]	2,340 I	4	123-4	*7.5*	Double	11.5	Crosshead	2	All purposes
9.	Freighter	8,350 D.W.	Transpacific	4	2,500 I	6	140	*7.0*	Single	10.0	Trunk	2	All purposes
10.	Freighter	7,650 D.W.	New York-R. Plate	4	2,300 I	6	148	*7.5*	Single	10.3	Trunk	2	All purposes
11.	Freighter	5,600 Displ.	R'dam-D. E. Indies	2[2]	1,150 I	4	85	*5*	Single	9.5	Crosshead	1	All purposes
12.	Ferry	3,120 Displ.	Korsör-Nyborg	4	4,000 I	8	180	*1.3*	Single	14-15	Trunk	2	All purposes
13.	Fast Pass.	2,282 G.	Baltic	4	3,500 B	10	260	*15.6*[3]	Single	15.0	Crosshead	1	All purposes
14.	Fast Pass.	1,000 G.	Baltic	4	1,347 I[4]	6	146.5	*3.4*[3]	Single	13.5	Crosshead	1	All purposes

[1] Airless injection attached scavenging. [2] External scavenging. [3] Calculated. [4] Trial type power. * Lub. oil consumption given when such is available.

This increase in operating radius was well borne out in preliminary investigations carried out by the Rotterdam Lloyd Ss. Co. before converting their steamer TURBINIA (5,600 tons load displ.) to Diesel power. She is now the motorship WIERINGEN with 237,475 cu. ft. of cargo space. She had originally turbine propelling machinery and her conversion was in the nature of an experiment to enable the company to learn something of Diesel performance prior to the completion of their big Sulzer-engined mail liner INSULINDE. The Diesel plant, which is a 4-cylinder 1,150 b.hp. (at 85 r.p.m.) Sulzer 2-cycle engine weighed 24 tons more than the old turbine plant. This weight included the weight of the oil fuel bunkers and the necessarily different main engine foundations. Ms. WIERINGEN carries 371 tons of Diesel oil, which at 5 tons per day for all purposes will give her a 70-day radius of operation. Ss. TURBINIA at the most could carry 446 tons of coal, which gave her an operating radius of 18 days. Reducing the motorship to the steamer's operating radius, however, 18 days, which is logical since the motorship would in the main run on the same trade route, the motorship has an actual weight saving of 314 tons.

Mr. Robert Haig of the Sun Sb. Co., Chester, Pa., gave some interesting figures covering the economy of motorshipping in a paper read a few years ago before the Society of Naval Architects and Marine Engineers, New York. He considers the case of a 12,500 ton dw. tanker of 3,200 i.hp. with oil firing, Diesel power with steam auxiliaries, and Diesel power with electric auxiliaries and arrives at the following figures for fuel consumptions.

Consumption 12,500-Ton Tanker (Tons)

	Steam Oil Burning	Diesel Steam Aux.	Diesel Elect. Aux.
Fuel per 20 days	660	300	210
Fuel 3 days spare	99	45	31.5
Fuel Raising Steam	20	..	....
Totals	779	345	241.5

These figures show a saving for the all Diesel ship over the steamer of 537.5 tons per trip or 1,075 tons per round trip. The motorship can either be constructed as a smaller dimensioned ship with equivalent cargo capacity, or as a ship with the same dimensions as the steamer but with larger capacity. This difference, while important in a tanker or a bulk cargo carrier, is perhaps best appreciated in a general cargo ship, where, owing to the nature of the cargo, extra space is always appreciated.

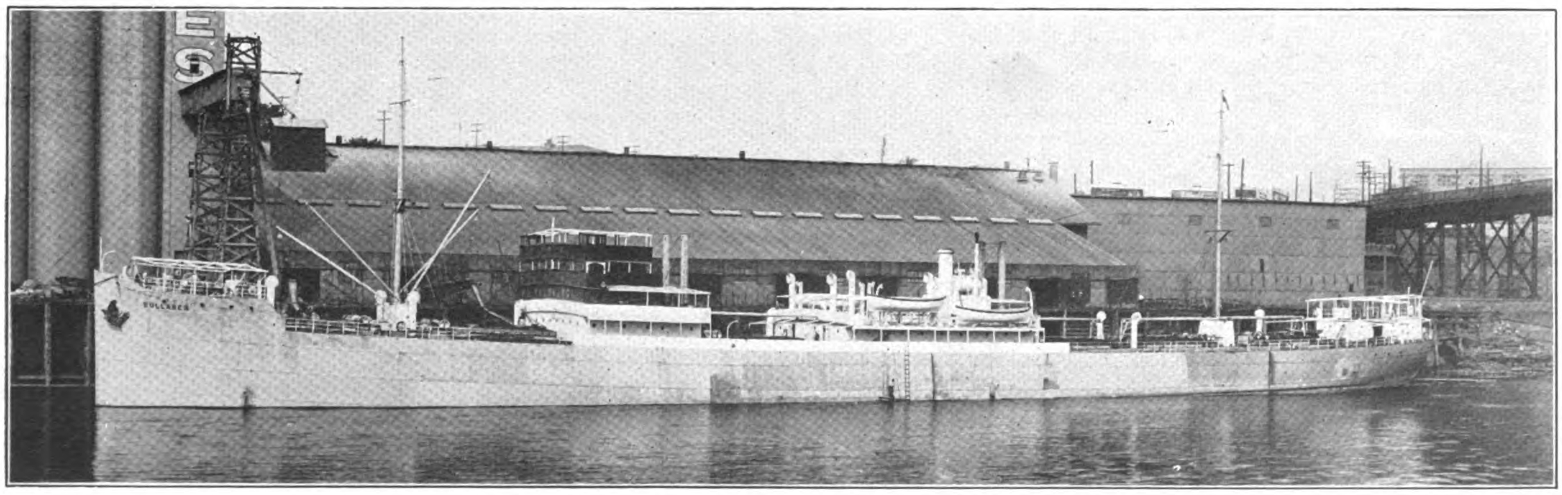
In the aggregate, how can steamers hope to stand up against fuel economy figures of this and similar types? Then, again, in port the motorship uses only one-tenth the fuel that the steamer uses and especially if electric auxiliaries are fitted. These incidentally speed up the time for loading and discharging. This point has not always been appreciated by the operator of coastwise ships because he feels that his ship is not at sea sufficiently to offset the higher first cost of the Diesel. This may have been true once, and may still be true with certain types of engines, but even so, the economies given average conditions, overcome this extra first cost in a time which varies almost directly with the consistency of use to which the ship is put.

The question is partly answered surely in that little item in the table above—"Raising steam ...... 20 tons." For the motorship there is no similar figure, because the motorship's engines are ready for operation the moment that "stand by" comes down from the bridge. This is no light matter in a ship making calls of varying duration at way ports, between terminal ports. If the calls are of short duration then, of course, practically a full head of steam has to be maintained all the while and this means that the fuel consumption remains at practically full all the time the ship is in port. Under similar conditions the motorship is using a generator set or sets with but sufficient current for winches, windlass and lighting.

The oil fired boiler, too, is needing extra steam all the while to operate the fuel oil burning mechanism. The pulverized coal burner is needing power to keep the pulverizer working. It is conceivable, in fact, that the straight hand fired coal burner is less expensive in that, in this instance, it uses less power-generated "foot pounds" than either of the other two.

It is more than probable that the port auxiliary loads on motorships will be reduced even further when a more general use of convenient storage batteries takes place—batteries which can be conveniently charged when the ship is at sea. The storage battery has never as yet been thoroughly appreciated and scarcely investigated by marine people.

It is, perhaps, important to remember that the picture of motorship economies which we present above does not represent the final canvass by any means. Much work of benefit to motorshipping remains to be



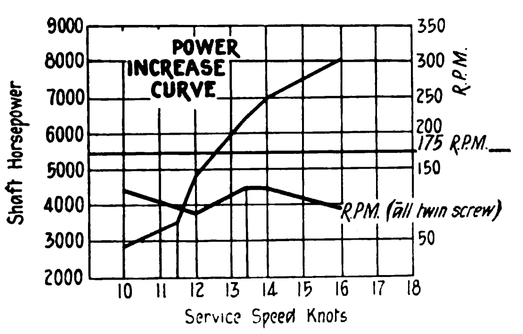
The 9250 ton dw., 3450 hp. Ms. Bullaren, here shown loading in the Columbia River for Australian ports, consumes 12 tons of Diesel oil per 24 hours, while a corresponding oil-burning steamer eats up about 25 tons per day in carrying out the same duties

done. Supercharging makes for economy in the fuel item and is an excellent booster for types of ships which require a little extra power in hand to make up time on a rigid schedule. Weight is a matter which always requires attention. Aluminum alloy pistons, which have been applied successfully to several American engines, are an important step in this direction. Increased centrifuging may make it possible to use a coarser grade fuel which will further add to the economy of motorshipping.

Neither is it likely that steamshipping will continue to allow the superlative economies of motorshipping to go unchallenged. Higher steam pressures, which permit of a reduction of the space occupied by existing turbine plants and a slight reduction in the fuel item and boilers with pulverized coal burning apparatus, are cited variously as being able to operate at a fuel economy which will seriously challenge that of the Diesel, or as having such a wonderful all round economy that the motorship must eventually disappear. The shipowner will, of course, be the ultimate deciding factor in the case.

It would seem, however, that he will require to be shown some very excellent steam economies when he finds that he can operate a 13,750 hp. ship like the GRIPSHOLM on 58 tons of fuel per day for all purposes, or a 13,000 hp. like the AORANGI on 55 tons of fuel per day for all purposes. Her steam driven sister NIAGARA uses 110 tons of fuel oil per day. She thus requires more than twice the fuel though 56 ft. shorter and 6 ft. less in breadth than the AORANGI and having passenger accommodations for 800 persons compared with the 1,000 which the AORANGI can carry. The latter's passenger accommodations is considerably more in proportion on account of space economies made possible by Diesels.

As a matter of fact, examination of the attached Table A of motorship fuel consumptions reveals some important points. These are representative freight ships and passenger ships which have all been in operation for sufficient time for their engines to have had their "rough spots" worn down. One is tempted with a table like this to try to make generalizations, but such would be difficult if not dangerous. Motorship performance does not yet appear to have reached a point in its development where one can make big generalizations regarding consumptions.



Curves showing increase of developed power with increase of speed and corresponding r.p.m.

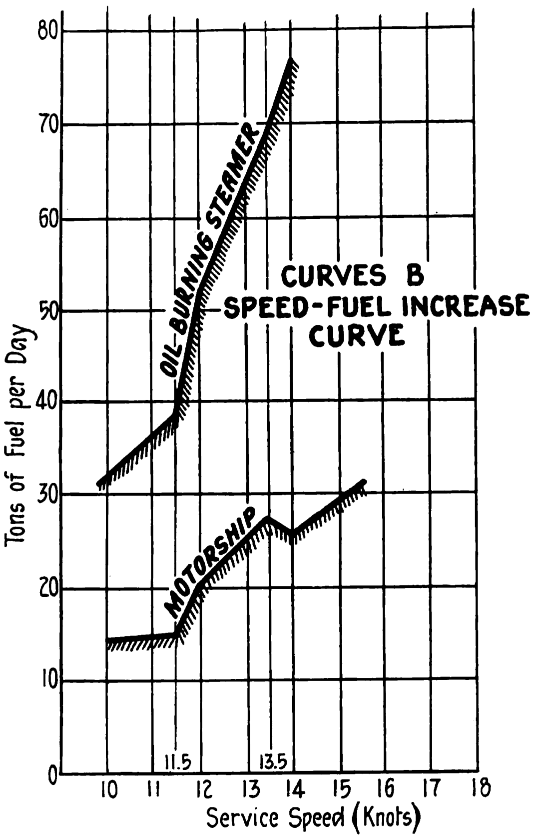
It is instructive to notice that examples 5 and 6 which are identical ships with 2-cycle and 4-cycle plants, respectively, have the same fuel consumption for all purposes per 24 hours. These figures are the means of several transpacific voyages, both eastbound and westbound. The lubricating oil consumption for the 2-cycle ship is less than that for the 4-cycle ship, but here again it would be dangerous to generalize because lubricating oil consumption often improves greatly as the ship's engines get worked into good running conditions. On her maiden voyage from England the AORANGI'S lubricating oil consumption has been quoted as high as 300 gal. per 24 hrs. while now she seldom uses more than 125

TABLE B—Speed-Fuel Consumption Increase 10-11,000 ton Motorships

(Fuel All Purposes Tons/24 Hrs.)

	Service Speed	Service Power	Fuel Tons/24 Hrs.	Lub. Oil Total	Oil Burning Steamer*
A	10.0	2,800 S	14	......	32
B	11.5	3,400 S	14.8	16 gal.	38
C	12.0	4,700 S	20.0	25 gal.	52
D	13.5-14	6,400 S	†27.0	......	69.2
E	14.0	7,000 S	25.5	37 gal.	77
F	16.0	8,000 S	....	......	..

*Round figures boiler consumption. †Estimated.



Curves B, in conjunction with Table B, show rate of increase of fuel—tons per 24 hrs.—usage with increase of service speed. The rate is greater for steamer than for motorship

gal. per 24 hrs. as the table (No. 2) shows. ASURA MARU (No. 6 in the table) had her lubricating oil consumption reduced from about 19 gal. per day on her maiden voyage to about 14 gal. at the present time.

Examples 7, 8, 9 and 10 are all in the 7-8,000 ton straight freight ships category such as motorshipping operators use for general cargo carrying in different parts of the world. For speeds varying from 10 to 11 knots they average regularly on service about 7 to 7.5 tons of fuel per day and are just about as economical as any cargo ship can be. This accounts for the popularity of such ships with charterers.

The slightly larger pulverized coal burning steamer MERCER, be it noted, burns 32.5 tons of coal per day for 9.5 knots speed—surely not much saving here.

Examples 9 and 10 have twin screw trunk piston Diesels, with a collective consumption equivalent to that of the single crosshead Diesels on the other ships. The lubricating oil consumption is naturally somewhat higher. Twin trunk piston sets have been adopted with considerable economy and success. Such engines, too, with their relatively small parts (19.68 in. piston diameter by 35.4 in. stroke for Example 9) make for easy overhaul. The twin screw installation, too, allows of certain overhauling at sea when the ship is running light. There seems to be rather a preference for a single slow speed engine on the part of many owners.

It is with the larger 10,000 ton dw. ships that recent increases in speed, and with it power, have taken place. We may examine, very usefully, some examples of this type, noting in passing that for an average 11 knot speed it takes somewhere in the nature of double the amount of fuel per 24 hrs. for all purposes to propel the extra 2,000 tons dw. between 8,000 tons and 10,000 tons. The 8,350 ton CHR. KNUDSEN uses 7.0 tons per day whereas the 10,500 ton ATAGO MARU uses 14.8 tons per day. With this increase in fuel consumption is an increase in power of about 1,500 i.hp. The 10,000 ton 11 knot oil burning steamer uses 38 tons per day, whereas the 10,000 ton (faster) 13½ knot motorship uses only 20 tons per day.

An examination of Table B, and of the curves attached to it shows in graphic manner just what an increase of a knot or so on the speed means in terms of service power and in fuel per day. These figures are taken from actual examples in service and are arranged on a constant comparison base of the 10,000 tons dw. ship. Actually many of the newest examples of high class motor freighters of 15-16 knots sea speed are larger ships with some passenger accommodation, but with speed, power, and fuel consumption all variables, it is necessary to have a definite constant. The 10,000 ton dw. freighter still represents a large proportion of long haul tonnage.

TABLE C—Power-Speed Increase 10-11,000 Ton Motorships

	Service Speed	R.P.M.	No. of Shafts	Cranks Per Shaft	Power
A	10	125	2	6	2,800 S
B	11.5	100-124	2	4	3,400 S
C	12.0	95[1]	2	4	4,700 S
D	13.5	125	2	6	6,400 S
E	14.0	125	2	8	7,000 S
F	16.0	...	2	6	8,000 S*

[1]Twin screw opposed piston. *Estimated.

TABLE D—Increase of Rated Power with Speed

Size	Speed	R.P.M.	No. of Shafts	Cranks Per Shaft	Power
60,000 G.	21	100	4	12	†100,000 Brake
32,000 G.	19-20	120	4	8	25,000 Brake
23,900 G.	18-19	125	2	8	20,000 Brake
22,500 G.	15-16	115	2	8	15,000 Brake
17,300 G.	16-17	125	2	6	†13,750 Shaft
17,491 G.	16	127	4	6	13,000 Shaft
16,000 G.	16-17	115	2	10	11,600 Brake

†Separately driven injection air compressors.

Notice that the jump from 10 knots to 14 knots means an increase in Diesel oil consumption for all purposes of 10½ tons, whereas, taking an average boiler oil consumption for steamers, the same jump means an increase of about 45 tons. In other words, the increase for steamers, when high speeds are considered, must make an owner think very seriously when this type of plant comes up for consideration.

Lubricating oil consumption (total per 24 hrs.) is shown in cases where this is available, but this in many cases is ex-

(*Continued on page* 48)

Extensive Shipping Board Conversion Program Will Materially Reduce Cost

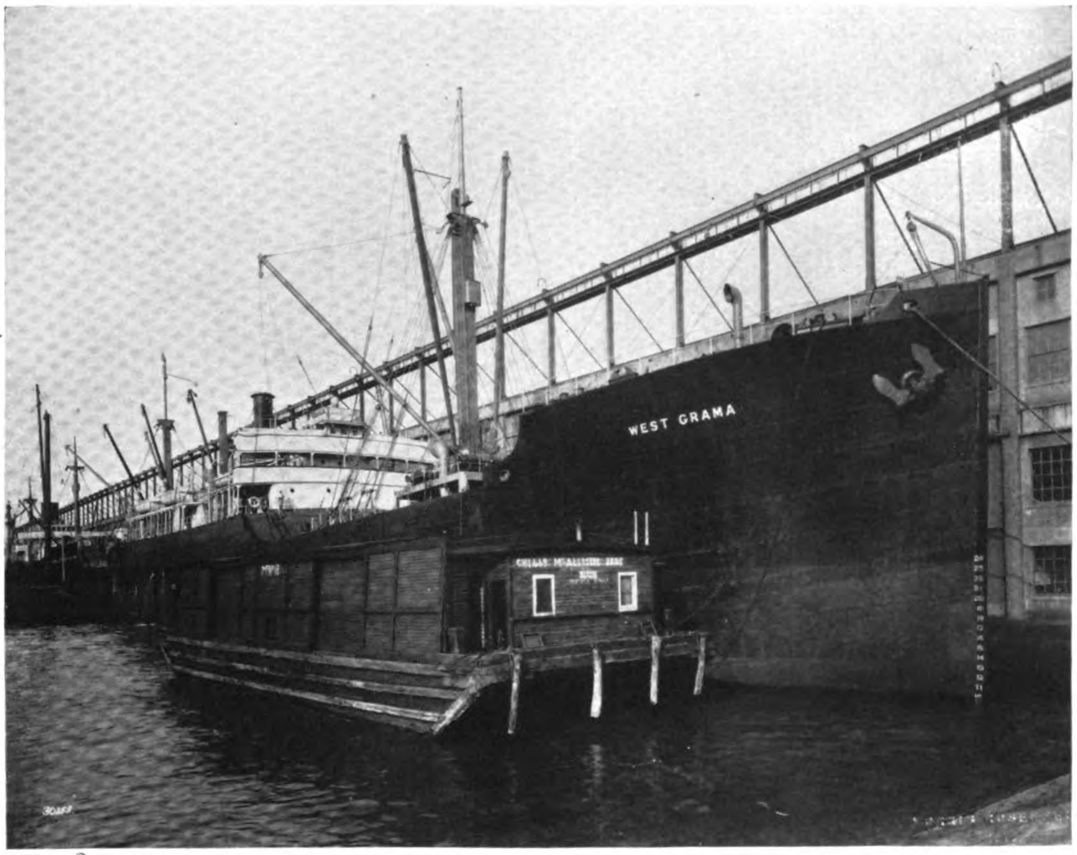
COMPLETION of the conversion of the Shipping Board freighter WILSCOX to Diesel drive in the next few weeks marks the finish of the Shipping Board's first conversion program. At such a time it is not without interest to take stock of the present position of affairs.

Just over a year ago the motorship TAMPA, the first vessel completed under the conversion program, went on service and has since been followed by 10 other vessels —all of which are now actively engaged in long-haul trade to various parts of the world, chiefly from New York to Australia, India, the Far East and South America.

Conversion Technique

These ships have been converted in such a manner that they embody in every way best practice in the art. If any criticisms are to be made it is that they are too slow and of insufficient capacity for fair competition with foreign-owned ships operating on similar routes.

The tendency today on principal long-haul trade routes is for a speed of about 13½-14 knots and a deadweight capacity of about 10,000 tons. The vessels converted under the first program are none of them over 9000 tons d.w.c., and their speed with the highest power that could conveniently be put into their hulls averages round about 12 knots. The 12 knot motorship is by no means a negligible factor in ocean trading today but we submit that she can only operate with any great hope of success on routes where competition with faster vessels is not likely to be encountered. Fortunately, on the Australia-India service, on which the majority of existing converted ships operate, there are few if any faster motorships running in competition.



If the Shipping Board would convert batches of 50 ships, prices would be so reduced that 4 ships similar to the 9000-ton McIntosh & Seymour-engined West Grama could virtually be converted free of charge

The Price of Development

Perhaps one of the most significant factors of the program just completed, however, is that it has given to American builders of Diesel engines a definite chance to show what they can do. Six different types of engines are represented in the fleet, and as far as we are able to ascertain from our own visits to the ships and from conversations with the operators, these engines have been uniformly successful. It would be folly to suggest that their builders sense in these engines finality, or to disguise that certain engine troubles have been encountered. This is inevitable where any development work is concerned.

Do not forget what it has cost Henry Ford to develop his new car. The experiment work which lies behind these first ships is surely in some ways comparable to the production of the first few of the new design cars.

The prices for these conversions have been criticised as being unduly high, and on the surface there has been much to justify such criticism because those who have criticised have not realized exactly what was involved. When a private shipowner is converting a steamer to Diesel power he considers what is the least amount of work he can do to re-equip his ship efficiently, and since the major economy of the motorship comes from the Diesel engine itself the hard-headed shipowner is generally willing to let it go at a modernization of the engineroom. The Shipping Board, however, thought otherwise. Not only did it modernize the enginerooms, but it rearranged the crew's spaces, brought up-to-date the navigation appliances, provided extremely comfortable passenger accommodation, and rearranged the deck auxiliaries. In short, it rebuilt the ships and, naturally, the average cost of around $60-$70 per deadweight ton was cavilled at by a number of people.

While a certain amount of reconditioning and even reconstruction on old hulls is unquestionably necessary, it should be well borne in mind that the object of the Dieselization program is to provide freighters capable of economic operation. There is no spare money to waste on frills.

Critics suggested that the cost of the engines was high. It is impossible to deny this, but remember that each engine was a custom-built proposition. If, instead of converting 12 ships the Board had gone straight out and converted 50 ships, it would have been a different story.

Quantity

For example in quoting on the eight engines for the ships ordered this last summer, engine companies were requested to bid on two, four and eight engines. One manufacturer entered a bid on ten engines.

The price per engine where two engines were figured on by this company for instance was $268,250 whereas the price per engine in lots of ten was $227,815—a saving of $40,335 per engine.

Had the Shipping Board been able to order 50 ships instead of eight and given orders for engines in groups of ten the saving on engines alone would have amounted to the huge sum of $2,016,750.

Four Free Motorships

The total cost of converting existing ships has been around $450,000 and on this basis it would be possible to add four extra motorships to our fleet out of the savings, i.e., virtually to obtain four 9,000 ton ships without expense for every 50.

It is conceded universally that United States needs in her mercantile marine large numbers of economically operating ships. We leave for a moment the question of who is to operate them.

The Diesel-engined ship is conceded today to be the most economically operated ship in existence for ocean trade route purposes. If that is so then the Shipping Board should go ahead and convert large quantities.

The next part of the program calls for the converting of eight ships of the NEW ORLEANS class, which ships are approximately the same size and of the same capacity as the existing ships. These eight ships will be propelled by four different makes of engine, and of the four manufacturers each manufacturer will receive two engines to build. This, of course is better than receiving one engine, but it does not represent anything like manufacturing on a production basis. It is conceivable that the cost will again be high and that the cost will be criticised. Why is the Board going at this conversion business in dribs and drabs? There are eight more ships in the same class which could easily be converted, and which would give each of those manufacturers four engines to build instead of two. There are still left in the Board's laid-up fleet many ships of larger carrying capacity, and still more ships of the same carrying capacity, all of which would make good and useful general cargo carriers if converted to economical Diesel power.

What is really wanted, of course, is new construction on a big scale. We have seen what this means in terms of money saving. A program for the construction of ten or fifteen 10,000 tons deadweight, 14 knot ships when completed would place the United States in a wonderfully favorable position for world carrying on long haul routes. Such a service, moreover, when placed on a paying basis by the Board could be handed over to private operators or could be sold to a private operator with the chance of that private operator being interested in it.

The next eight ships converted will be ready for service in about 10 months it is estimated. In 10 months' time there will be nine or ten 14-16 knot Diesel-driven freighters operating out of New York to South American ports under British and Norwegian flags. The Shipping Board by that time will have Dieselized under its conversion scheme only eighteen 9,000 ton, 11-12 knot ships, many of which are intended to run in competition with these 16 knotters. It is a pity that we cannot get more action in this matter. Diesels make for cheap transportation.

Shipping Board's Diesel-electric Conversions

PLANS for the conversion of three cargo boats, the TRIUMPH, COURAGEOUS and DEFIANCE, have now been completed by the Gibbs Bros., Inc., for the United States Shipping Board. All three boats are now equipped with geared-turbine, single-screw drive, and this will be superseded by modern Diesel-electric drive. COURAGEOUS will be converted by the Federal Shipbuilding Company, TRIUMPH by the Boston Navy Yard and the DEFIANCE by the Norfolk Navy Yard.

We are informed that the COURAGEOUS will be the first boat to be converted. Four 1280 hp., 250-r.p.m. Diesels will be supplied by the McIntosh & Seymour Company. Each engine will be direct connected to two electric generators, one supplying power for propulsion and the other, excitation auxiliary power and lighting.

The electric equipment for this vessel will be furnished complete by the General Electric Company. The main generators will be four 800 kw., 250 r.p.m., 375 volt, direct-current marine generators, while the auxiliary generators will be four 100 kw., 250 r.p.m., 240 volt, direct current marine type machines. The propulsion motor will be a double-unit type consisting of two motors on the same shaft, each rated 2000 hp., 60 r.p.m., 750 volts, shunt wound, and direct connected to the propeller shaft.

Generators and motors will be connected in series. The control will be of the variable voltage type with operating stations both in the engine room and pilot house. The switchboard will consist of two parts, one for controlling the propulsion generators and the other for controlling the auxiliary generators, and distributing current to the engine room auxiliaries, deck auxiliaries and lighting system. The main switchboard will be of dead-front construction, while the auxiliary board will be of the usual live-front type.

All deck and engine room auxiliaries will be converted to electric drive, utilizing motors aggregating approximately 700 hp.

It is expected that as a result of the conversion, the speed of the vessel will be advanced from approximately 10 to 13 or 14 knots. Certain modifications will be made to the ship's hull lines and propeller to aid in increasing the speed.

Converted, the ships will have a displacement of 10,500 deadweight tons each, and each will have 600,000 cu. ft. of cargo space.

They should be capable of competitive freight carrying on many long hauls.

Ship Operators See Motorship Domination

THE increasing importance with which the shipowners regard motorshipping is well reflected in the January issue of *Pacific Coast Shipping*, organ of the General Steamship Corp., San Francisco.

The performance of the Pacific Coast market in the last 12 months—says the report in question—is remarkable when it is considered that during the entire season of greatest activity, that is to say for the last four or five months, the Pacific trades have been fairly inundated with tonnage from other world sections which were not carrying their customary requirements. While the failure of other world trades to absorb their accustomed tonnage this fall must be regarded as essential to the understanding of the Pacific Coast market, there is still another highly important factor of an equally general character. This is the more commanding position which the motorship has assumed in world commerce. *We are passing through a period of elimination of obsolete and semi-obsolete tonnage, the typical old slow "tramp" freighter of a speed of nine or ten knots, the coal-burners and such craft which can not compete on an operating basis with the more economical motorship.* This is well exemplified by the large amount of new motor tonnage constructed and under construction, particularly when it is borne in mind that the owners are building these bottoms in the face of generally depressed freight rates. The apparent answer is that these revenues are not too low for the motorship. Since the existing rates are not profitable for less efficient tonnage, there is a well defined tendency to substitute motor for steam tonnage in all branches of trade, charter as well as liner. The italics are our own.

A Sidelight on Pulverized Coal

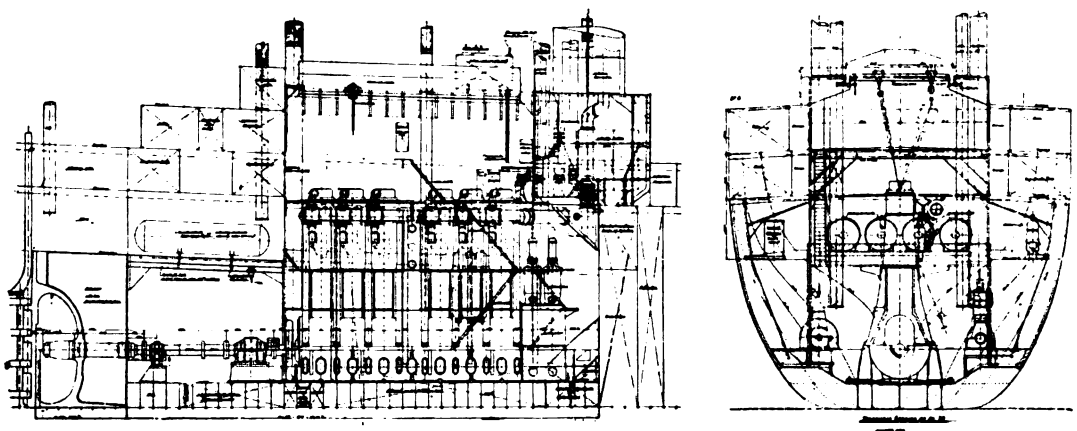
AN interesting sidelight upon pulverized coal firing is to be found the cast iron balls used in the pulverizer to reduce the coal to small particles before it finally reaches the furnaces under the boilers. The balls are in fact the most important part of the pulverizing equipment because they, in effect give to the coal its "liquid" properties. These balls, although cheap, in the aggregate constitute an important item of weight. They are consumed, we are informed, in the process of grinding the coal, at an average of 25 lb. of balls per ton of coal burned. A 9000 ton 3000 hp. freighter with pulverizers burns in round figures about 30 tons of coal per day. She consumes therefore (30 x 25) = 750 lb. of balls per day. On a 14 day crossing of the Atlantic she will use (750x14) = 10,500 lb. = 4.6 tons of balls. On her return voyage she will consume the same amount. She must carry, presumably, enough balls for the outward trip and for the homeward trip plus an emergency surplus. This means carrying 9.2 tons, or, say, with surplus 10 tons of balls. The proportion of balls very naturally increases with the size and power of ship and storage space must be provided for the balls. This space although not large might usefully be employed for other purposes, and the point to be made is that with any pulverized coal plant you are necessarily carrying about with you all the time a quantity of material to do your work for you which is lying idle.

Twelve Tankers With Double-Acting Diesels

Anglo-Saxon Co.'s "Standard" Fleet of 10,000 Ton Motor Tankers with 3000 Hp. Double-acting 4-cycle Diesels

THE single-screw motor tanker BULLMOUTH, which has recently been completed on the Tyne for the Anglo-Saxon Petroleum Company, London, is one of a fleet of twelve tankers, propelled each by a 3,000 hp. Werkspoor double acting Diesels, completed during the past few months. These are fast vessels capable of maintaining a service speed of about 12 knots. They are 440 ft. in length, 59 ft. in breadth and 34 ft. 9 in. in moulded depth from the upper deck, and are built on the combined transverse and longitudinal system of framing. Two longitudinal bulkheads with transverse bulkheads are arranged to form oiltight compartments for oil cargo with cofferdams at the forward and after ends. A tank for oil fuel is fitted forward with a hold and cargo 'tween deck above, and there is provision for water ballast in the forward and after peaks. All the cargo tanks have heating coils. The main pump room is amidships and contains powerful pumps connected to a system of pipe lines in the cargo tanks and supply and discharge lines on deck. In addition to the main pump room there is a small pump room forward with the necessary pumps for oil fuel, bilge and ballast suctions.

The propelling machinery consists of a single set of double-acting Werkspoor engines. Power is developed in 6 cylinders. High pressure air for the injection of the fuel to the cylinders is obtained from air compressors driven off the main engines. Pumps for circulating water, piston-cooling water, forced lubrication and bilges are driven through levers from the air compressors. One of the features of the main engines is the cylinder head, containing combined exhaust and inlet valves. The combination consists of six valves housed in the cylinder head and operated simultaneously by a crosshead immediately above the cylinder cover. The motors are so designed that overhauling may be quickly carried out, while all parts are easily accessible. The bottom side of the cylinder is fitted with a combustion chamber attached to the lower cover at the side wherein are housed the exhaust valve and inlet valve. Attached to the side of the combustion chamber is the housing containing the combustion chamber cover.



Typical machinery layout for the Anglo-Saxon Co.'s fleet of twelve 3000 hp. tankers each fitted with a double-acting 4-cycle Diesel

One camshaft only is fitted carrying two sets of cams for ahead and astern running, the cams being in contact with rollers and levers operating the top valves and with additional push rods for the lower valves. Starting is by compressed air stored in tanks and admitted to the bottom sides of the main engine pistons, the upper sides firing on oil as soon as the necessary position is obtained. During this operation the exhaust gases from the top side of the pistons are directed by a special automatic valve to the bottom inlet air pipe and admitted on the suction stroke of the bottom side of the pistons. By this process preliminary heating is carried out prior to the admission of oil when the bottom fuel valves begin to operate. Manœuvring is controlled at the starting platform, operations being assisted by an electric motor. Two boilers for providing steam for the deck auxiliaries and certain pumps in the engine room are placed on the upper deck forward of the engines and are equipped for exhaust gas heating as well as for oil fuel burning. The machinery layout of the BULLMOUTH class of ships is shown herewith.

The twelve motor tankers of 10,000 tons each, have now all been completed, and the results are excellent. The first vessel, PHOBOS, which recently transited the Panama Canal, has now been running for over 12 months, covering a distance of 70,000 miles, during which time she has never been delayed for repairs or any expenses incurred on account of repairs.

Private or Government Operation?

ACCORDING to an Associated Press dispatch to the New York *Sun* of December 24, "a shipping row is brewing at the Capitol with advocates for a Government-owned merchant marine pressing for legislation in the face of the administration policy which favors turning over the remainder of the existing fleet to private operation.

"The Senate Commerce Committee has shown a willingness in its early discussions of the question to act favorably on the proposal of Chairman, Wesley L. Jones, Republican, Washington, for a large replacement program of ships to be operated under the present shipping board.

"Approval by congress of such a proposition seems certain to meet strong opposition from President Coolidge, who time and again has made it known that he wants the Government out of the shipping business and as soon as possible. He has always complained of the losses incurred by the Government in maintaining those ships it has not sold.

"Although usually one of the administration estalwarts, Senator Jones is determined to build up the Government merchant fleet which would require administration by the Government under the Shipping Board. His replacement program calls for not specific appropriation, but it is understood the scheme he has in mind has been estimated by the Shipping Board to cost $200,000,000 over a ten-year period.

"Senator Jones has been joined by Senator Duncan V. Fletcher of Florida, ranking Democrat on the commerce committee, and survey of the committee membership has shown a majority for the bill."

Big Tanker Converted

As we close for press, we are able to announce the successful completion of trials of the tanker J. A. MOFFETT JR. owned by the Standard Shipping Company, 25 Broadway, New York. This ship has been converted from steam by the Tietjen & Lang plant of the Todd Shipyards Corp. Her steam machinery has been entirely removed and in its place have been substituted two 4-cylinder Hamilton-M.A.N. single-acting 2-cycle Diesels each of 1500 s.hp. at 90 r.p.m. having a cylinder diameter of 27.5 in. and a stroke of 47.25 in. The motorship J. A. MOFFETT JR. is a sister ship to the E. T. BEDFORD converted early last year to Diesel drive by the Federal Sb. Co., Kearney, N. J. She has a length b.p. of 499.2 ft., a beam molded of 68.1 ft., and a depth molded of 30.5 ft. The deadweight tonnage is just over 15,000 tons so that it will be seen that the ship ranks among the largest tankers in commission.

The main engines are installed in the original compartment aft. The total length of the engine room is 76 ft. 6 in.

The United Steamship Co., Copenhagen is currently reported to be considering construction of a motor passenger line.

The Shipping Board Motorship West Grama

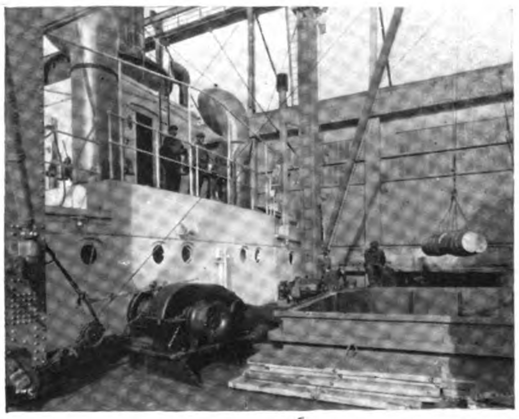
Newest Conversion, Now in New York—South America Trade
Has Double-Acting 4-Cycle Diesel of 2700 Hp.

THE motorship WEST GRAMA, which made her sea trial from the port of Boston last month, is the last, but one, of the ships to be converted to Diesel power under the Shipping Board's conversion scheme.

The WEST GRAMA is one of the Los Angles type of Shipping Board ships and is a sister to the WEST HONAKER, the WEST CUSSETA and the CROWN CITY, all of which are fitted with McIntosh & Seymour single-acting engines of 2700 brake hp. But, whereas these three vessels had their superstructure rebuilt for passenger accommodation, the WEST GRAMA has not been similarly treated. In fact, outside her engineroom she has had less done to her than any of the Shipping Board vessels yet converted. The crew accommodation, for example, still remains in the poop as it did when the ship was a steamer. It is not on the poop as is the case with other ships previously converted. The manual steering gear remains on the poop and the steering gear itself is in the poop. The only structure that has been built on the poop-deck is a small entrance house. Amidships the engineers' accommodation has been left largely as it was. This also applies to the officers' accommodations—and the navigating room. The winches have, however, been raised from their position on the main deck to winch houses—an improvement from the cargo carrying efficiency point of view so obvious as to render its omission impossible.

Characteristics of MS. West Grama

Gross tonnage	5,326 tons
Net tonnage	3,306 tons
Length overall	425 ft. 1 in.
Length b. p.	410 ft. 0 in.
Beam, molded	54 ft. 0 in.
Depth, molded to upper (main) dk.	29 ft. 9 in.
Draft (load)	23 ft. 11¼ in.
Power, main engine	2,700 b.hp.
Service speed, about	12 knots
Total deadweight capacity	8,000 tons
Fuel oil, double bottom	885.0 tons

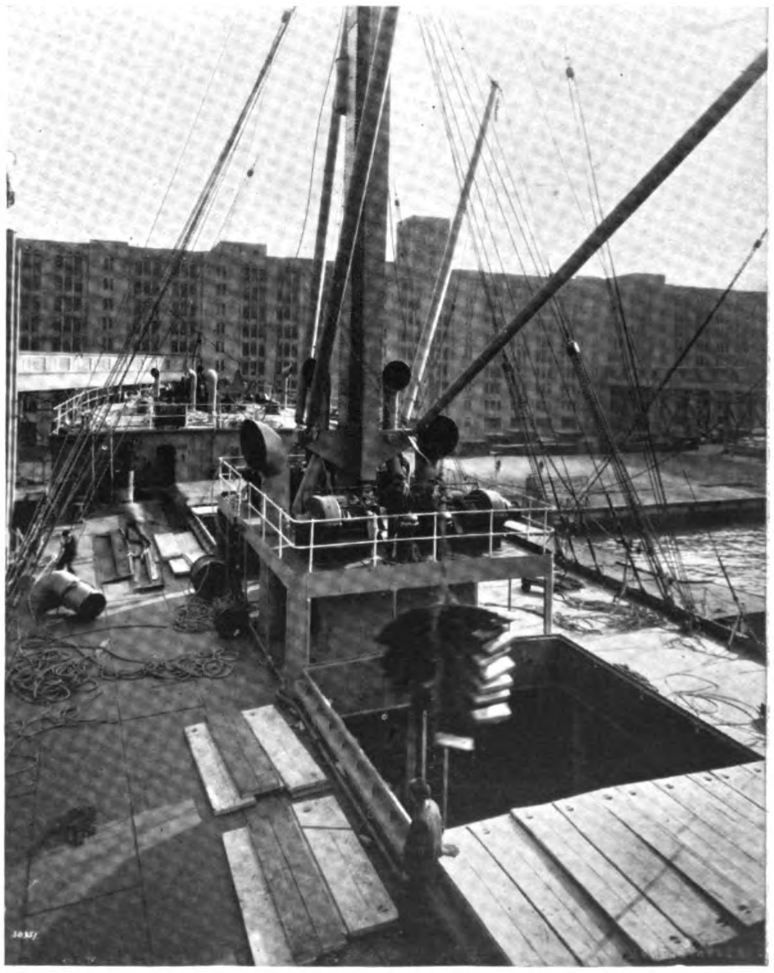


An excellent example of remote control of winches

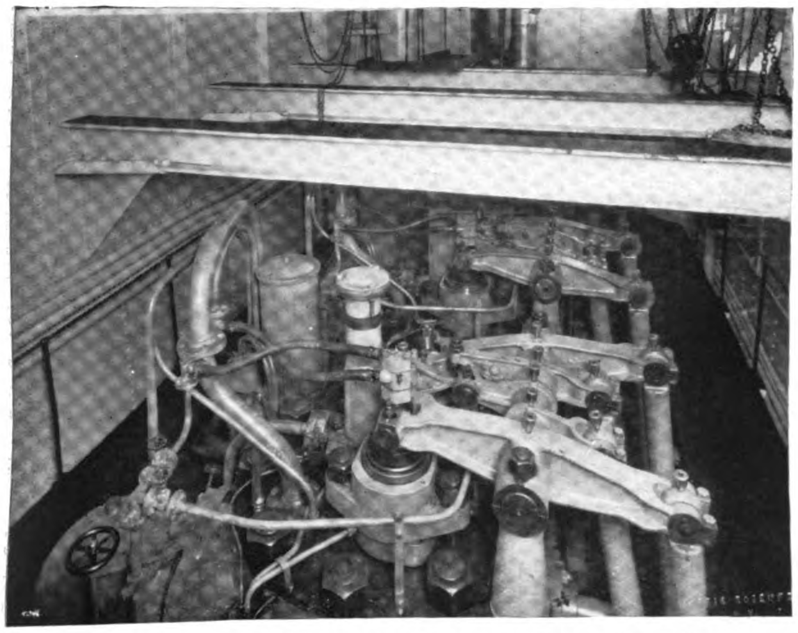
She is fitted with a 4-cylinder, double-acting, 4-cycle, air-injection McIntosh & Seymour Diesel of 32 in. cylinder diameter and 52 in. stroke. This engine is rated for 2700 brake hp. at 95 r.p.m. and has a piston speed of 823 ft. per minute. The engine is wonderfully compact and the absence of length in fore and aft direction makes for a roomy engineroom. The engine drives its own injection air compressor. The ship has been converted by the Bethlehem Sb. Co., at their Fore River plant, Quincy, Mass., and is now being operated by the American Republics Line, New York.

We have remarked that the engineroom is compact, and roomy. It contains on the starboard side two McIntosh & Seymour generating sets each 2-cylinder, single-acting units of 13⅝ in. cylinder diameter and 18 in. stroke. They develop 108 brake hp. at 275 r.p.m. with a piston speed of 825 ft. per minute. Each engine drives a 75 kw. generator supplying current at 240 volts and each has an excess air capacity of 170 cu. ft.

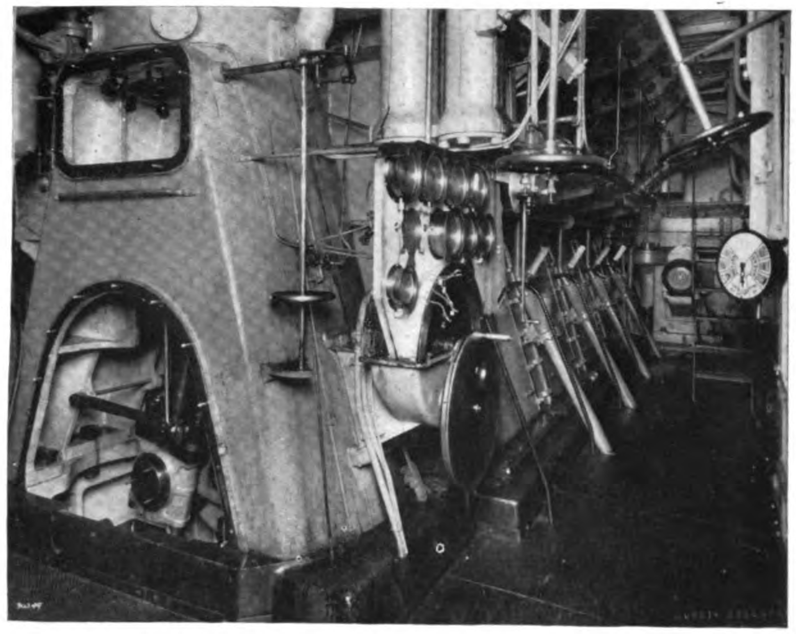
Exhaust from the McIntosh & Seymour main Diesel is taken through a characteristic shipping Board stack



Ms. West Grama loading a capacity general cargo for South America on her maiden voyage



Cylinder tops of the McIntosh & Seymour main engine

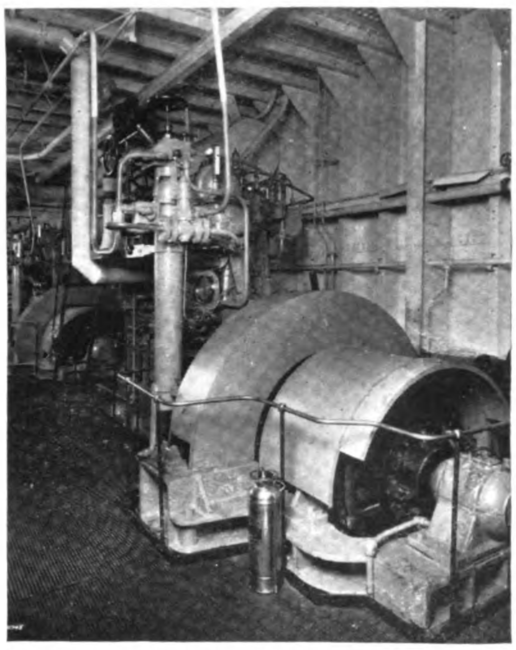


Main engine control position on the port side

riving in New York to load she went from Boston to Philadelphia for part cargo.

On the run from Philadelphia to New York the ship averaged 13.44 knots at about 95.7 r.p.m. of the main engine. The drafts leaving Philadelphia were 17 ft. 3 in. aft and 7 ft. 4 in. forward. Arriving at New York the corresponding figures were 14 ft. 4 in. aft and 10 ft. 10 in. forward. It is expected that the vessel's fuel consumption per 24 hours for all purposes will be about 12.5 tons. As a steamer she used about 30 tons of oil under her boilers per 24 hours.

The main McIntosh & Seymour engine has four double-acting cylinders of 32 in. diameter. With a piston stroke of 52 in. and turning at 95 r.p.m., the engine develops 2700 b.hp., driving its own compressor. For economy in production the 32 in. cylinder was selected because that is the cylinder diameter of the big single-acting engine, and many parts such as the upper cylinder heads, upper valve gear, etc., can be duplicated in the two styles of engines. Normally this type would be built with 60 in. stroke, but in order to reduce the power to contract the stroke was cut to 52 in. In bigger engines of the same type the number of cylinders can be increased to six or eight, or even to nine and to ten, and the compressor need not necessarily be direct-connected with the engine,—there is indeed a trend towards the independently operated compressor in multi-engine installations of large power on many ships.

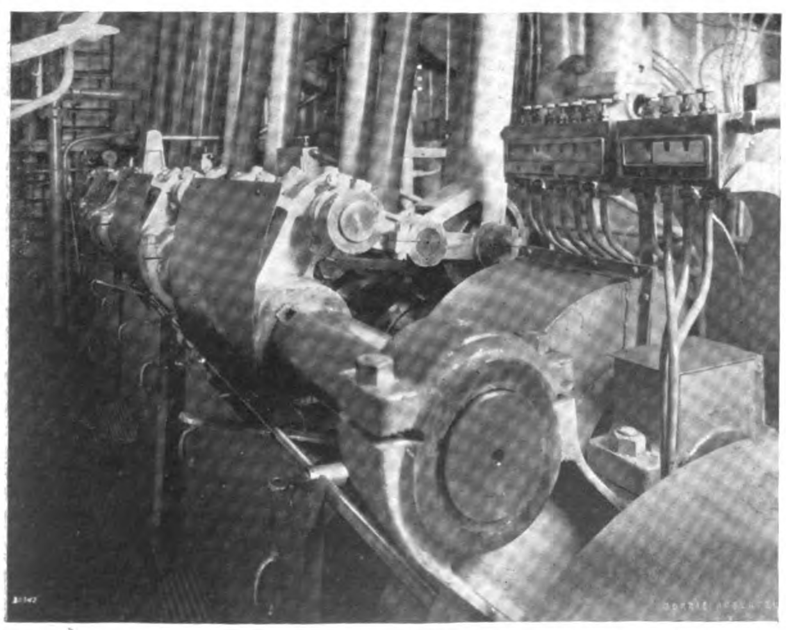


One of three 75 kw. Diesel generator sets

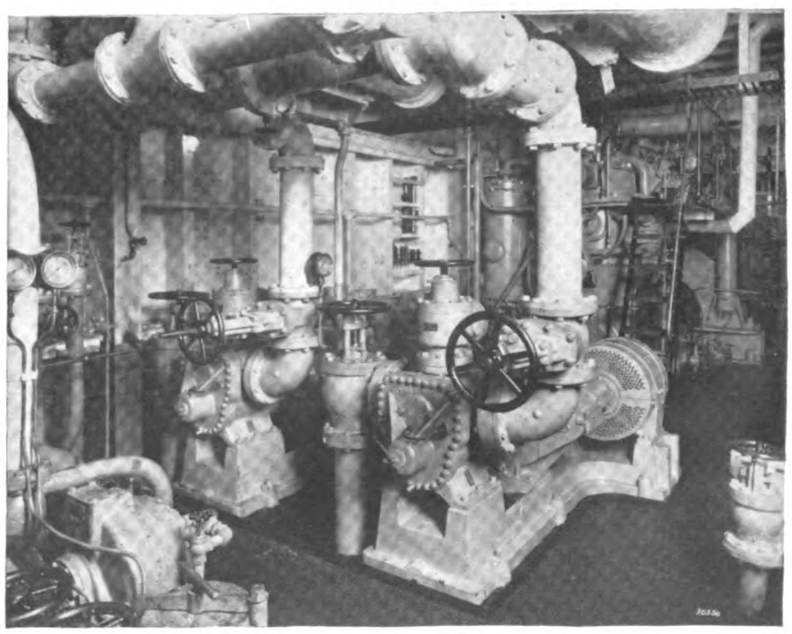
Bedplate, framing, crankshaft, upper cylinder covers and valve gear, fuel pumps, control, etc., follow the lines of McIntosh & Seymour single-acting practice. The new design of this interesting engine is in the lower cylinder covers and valve gear, pistons, piston rods and cylinder liners.

The general equipment of the ship follows largely that used for previous conversions. There is a Sperry telemotor with a Westinghouse control panel, a hand steering control aft with an automatic follow up, and a hand control with non follow up attachment. Sharples centrifuges are fitted.

The 10 Lidgerwood cargo winches are of self-oiling type with Westinghouse motor drive and an improved cam type controller which may be seen in the illustration we produce elsewhere in this article. The winches are fitted with Cutler-Hammer shoe brakes. The windlass has been specially rebuilt for motor drive, and has a 45 hp. motor and control panel. A Cutler-Hammer shoe brake is here fitted. There is a complete Walter Kidde Co$_2$ fire extinguishing system.



Looking along the main engine camshaft



A pump group in a wing of the engine room

An Electric Package Freighter

ONE of the most important applications of marine Diesel-electricity from an academic as well as from a practical standpoint is its adaptation to one of the many "runabout" packet boats which abound in New York harbor. Diesel economies have too long remained unrecognized by the operators of such vessels.

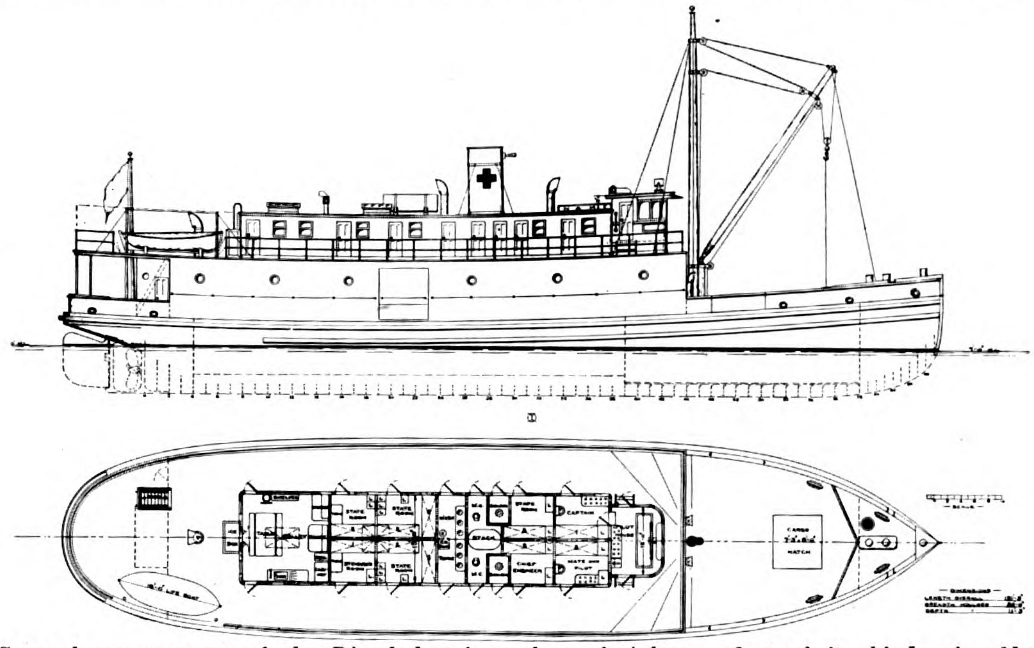
It is conceivable that a new field for electric ship propulsion will be opened with the completion of an electrically propelled packet boat now being built for the Middlesex Transportation Company of New Brunswick, N. J., by the Bethlehem Sb. Co., Quincy, Mass.

This boat, designed by Eads Johnson, Naval Architect of New York, will have a capacity of 250 tons of package freight and will operate at a speed of 12 miles per hour. It will run between New Brunswick and New York City and will supplement an extensive trucking business carried on by the owners.

The boat will be completely electrified, and will thus represent the first application of electric drive to packet service. Electric equipment will be supplied by General Electric Co. The power plant will consist of two Winton Diesels, each rated 250 hp. and running at a speed of 375 r.p.m. Each engine will drive a 165-kilowatt, 250-volt, direct-current generator, each generator being equipped with a direct-connected exciter rated 15 kw., 120 volts on its shaft.

The propeller shaft will be driven by a direct-connected, 400 hp., 160 r.p.m., shunt-wound, direct-current motor. The boat will be controlled by the variable voltage method, with operator's stations in both the pilot house and the engine room below.

The boat's auxiliaries will also be electrified, including steering gear driven by a 15 hp. motor; hoisting winch, driven by a 25 hp. motor, and various motorized pumps. Pilot house control will be used mainly.



General arrangement of the Diesel-electric package freighter—first of its kind—for New York, building at the Bethlehem plant at Quincy, Mass.

Another Diesel Lighter for New York

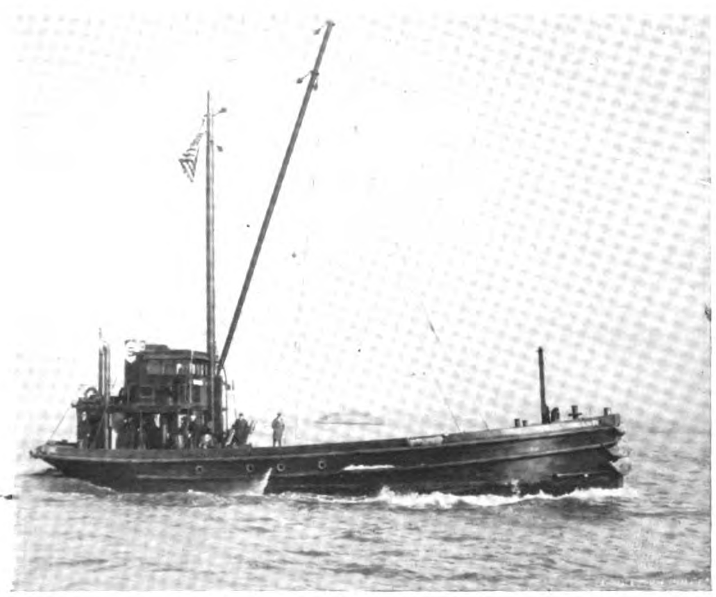
A WOODEN Diesel driven derrick lighter, DIAMOND S. No. 89, owned by the William Spencer & Son Corp. ran trials last month in New York Harbor. This boat was designed and built by Jakobson and Peterson, Inc. of Brooklyn, N. Y. Her characteristics are as follows: Length overall 91 ft. 0 in; beam outside of planking 28 ft. 0 in.; depth of hold midships 10 ft. 6 in.; load draft 8 ft. 6 in.

The boat is of heavy construction throughout, the frames being 8 in. double sawed oak spaced 18 in. centers, the planking of 3 in. yellow pine, heavy clamps and shelfs, and all in accordance with best commercial practice. The boat is propelled by a 360 hp. Fairbanks-Morse Diesel, driving a 4-blade semi-steel wheel 72 in. diameter by 56 in. pitch, which gives the vessel a good speed, and provides for plenty of reserve power.

The auxiliary machinery consists of a 6-8 hp. Hill Diesel clutch connected to a Fairbanks-Morse 2-stage air compressor, and similarly connected to a 3 in. suction and 3-in. discharge Northern Rotary pump, used as a general service pump for fire, bilge suction, wrecking suction, and circulating water pump for main engine if required. A Fairbanks-Morse 32 volt generator is chain driven from the Hill Diesel, charging the storage batteries which provide light to the vessel.

The hoisting machinery consists of a 9 hp. gasoline driven winch and engine, which is placed entirely separate from the other machinery, in the winch room under the pilot house speed is 9 m.p.h.

With a cargo capacity of 200 tons, a large deck space, plenty of reserve power, and a crew of but four men, this boat should prove an efficient unit.



Diesel derrick lighter Diamond S. No. 89 has 200-ton cargo capacity

The large clear deck space is a very special feature

The Editorial Viewpoint

"Et Tu Quoque!"

STEAMSHIPS, it would appear, have their troubles no less than motorships. The actual fact of the matter is that all ships have their troubles and are liable to have them at any time. We do feel inclined to put forward a plea, however, that whereas the steamer's troubles are taken more or less as a matter of course, the motorship's troubles have an occasional habit of collecting size and multiplicity in the course of circulation from person to person. How many gruesome stories, for example, have gone around from time to time concerning the excessive vibrations felt in certain large passenger motorliners? Many of the stories were unfortunately correct in their less exaggerated form. But how much publicity has been given to the case of a certain large transatlantic liner with steam reciprocating engines which have proved so unsatisfactory that it is necessary to remove them altogether and substitute some other form of propulsion? One remembers, too, when a large passenger liner was ignominiously towed back to New York with severe turbine trouble. No large motor passenger liner has yet had to return to port under tow. Quite recently the ILE DE FRANCE stripped two of its turbines while entering the port of Havre. This necessitated the replacing of thousands of blades. The total work will occupy about 2 months. On the other hand, in all fairness, we must admit knowledge of motorships which have been laid up for periods for readjustments. The whole thing boils down to an acknowledgment of the fact that we still have much to learn in all branches of marine engineering. But nothing can be gained by hush! hush! methods. Let everyone make a definite statement on his troubles. The profession at large will benefit and harmful rumors will be stopped.

Powering for Lightships

EARLY LAST YEAR a Diesel powered light vessel went on service off the Delaware River. In describing this ship at that time we pointed out that while the Diesel engine was unquestionably ideal for the work, from a fuel economy standpoint a better power distribution could unquestionably be obtained with a Diesel-electric plant. Bids have recently been called for a powerful well equipped lightship for service on U. S. coastlines. This ship will be Diesel-electric equipped. It will be, when completed, a noteworthy addition to the shipbuilding art. All American lightships are powered for propulsion as well as for lighting. British lightships, for example, have no propulsive power. They operate, however, in less exposed positions than many American lightships all of which must have power equipment. Old style lightships employed steam for propulsion to and from their stations and this is used two or three times a year to take the ships back and forth to their stations. New style lightships use electricity for a variety of purposes—so much so that generating sets are a necessity on board. The propelling prime mover is lying idle for a great proportion of the vessel's active life. This represents, with a steam plant, a large amount of machinery doing nothing. With a Diesel propelling engine the amount of time idle is even greater because such is the fuel economy of the Diesel generators that the motor lightship can stay on station for a whole year without refueling. The steamer has to return to port two or three times. It would seem, therefore, natural to suppose that maximum economy within minimum space can be secured by a Diesel-electric layout such as the new ship will have. The number of generators used can be proportioned exactly to the existing load. This is another example of the adaptability of Diesel-electricity to certain specialized ship types.

Diesel-electric Conversions

AN EXAMINATION OF the plans of the Diesel-electric conversions for the U. S. Shipping Board gives much food for thought. There are those among us who have been inclined to cavil at the immense cost—about $130 per ton deadweight which these conversions will entail. There are those who consider that reconstruction of the hull form in conjunction with Diesel-electric drive is nothing short of madness. Is it? Perhaps the answer is best supplied by an examination of what we are going to get as a result of these conversions. An unbiased examination forces the conclusion that we are getting a group of 10,000 ton dw. 13 knot motorships for the American mercantile marine. It is conceded that the only type of motorship which is capable of holding its own in competitive hauls on ocean trade routes today is a ship of this type. At any rate this is so where the best grade cargoes are considered. The existing Shipping Board conversions and those of the NEW ORLEANS class which are about to be carried out are excellent in that they provide the American merchant marine with motorships. They do not provide it with motorships capable of open competition with the big British ships on routes to the Far East and to South America. As far as we have been able to ascertain the Diesel-electric conversions will provide ships which can compete with such vessels with a reasonable measure of success. A most interesting point is the modification of the stern frame and the removal of much deadwood aft which with a semi-balanced rudder and an extremely slow running propeller—not more than about 80 r.p.m., we understand—will go a long way towards making up the electrical losses. Fining of the fore end in conjunction with this will give the ships a speed of about 13½ knots in service. This work is concerned with the part forward of the fore peak bullkhead and with the stern frame only.

Advantages of Quantity Production

AN ADVANTAGE OF Diesel-electric propulsion, which in the welter of opinions and counter opinions on this type of powering, appears to remain neglected, is that it tends to permit of manufacturing on a production basis. Diesel-electricity requires more engines per ship than straight Diesel drive. The electrification of three ships for the Shipping Board, will result, as we have pointed out, in 12 engines going to the McIntosh & Seymour plant at Auburn. The construction of a fleet of six ferryboats for the Southern Pacific Co.'s San Francisco Bay service last year resulted in a contract for 24 engines going to the New London Ship & Engine Co. Similarly the Electric Ferries contract gave the New London Co. an opportunity to produce 12 engines. The Atlantic Refining Co.'s recent conversion of three steam tankers to electric drive has enabled Ingersoll Rand to supply a total of 9 engines. It would seem that Diesel-electrical possibilities can be regarded with some favor by all marine Diesel builders located in the United States because it will give them a volume of work and at the same time enable them to quote at prices which will be attractive to the shipowner. In the fast coastwise field, for example, there is much to recommend Diesel-electricity because it enables the total power to be conveniently split up into a number of units suitable to space and layout requirements. By these remarks, of course, we do not advance Diesel-electricity as the universal solution to marine propulsion problems. For straight freighters, building as new ships, it is conceivable that a direct Diesel drive is by far the best thing. There are many fields for direct Diesel drive. It is an interesting thought, however, that Diesel-electricity may conceivably bring about reductions in engine price, because it permits of building on a production basis.

Low Fuel Consumption and Quick Turn Around

ECONOMY IN THE FUEL item is one of the most important contributory items to the motorship's success. Do we always realize to the full what this economy amounts to in cold figures? A thorough analysis of figures of performance with a view to such a determination reveals some extraordinarily interesting facts. For this reason special attention is drawn to the article on page 19 of this issue which determines for the motorship the title, conserver of fuel. Besides being a conserver of fuel, it is at the same time a saver of money. It is a direct answer on the first count to those who foretell an oil shortage because of the rapid rate at which the mercantile marines of the world are using oil. The motorship uses say 30-40 tons of oil fuel where the oil burning steamer uses 10-12 tons. In a large ship like the big Diesel mammoth, which the White Star Line are currently reported to be building, the saving amounts to some 9,000 tons of

space. Then, again, consider the question of quick turn around. The BERENGARIA of the Cunard Line recently arrived in New York, delayed 16 hours by fog off the Narrows and 8 hours by storms on her passage. She had between 14 and 16 hours in which to turn around. And in that time she had to complete bunkering. Had she been a coal burning ship, or even a pulverized coal burner, such a turn around would absolutely have been impossible. She is an oil burner and oil of course has a flexibility to which coal can never hope to attain. She bunkered 43,000 bbl. of fuel oil during the time she was in port and took on board also 3,400 tons of fresh water. The point to be made, of course, is that the motorship of similar size would have an even quicker turn around than the steamer because she would require considerably less fuel. If the White Star Line goes ahead with its motor mammoth we shall have an opportunity of seeing what can be done in this direction.

Much Quicker Than Steamers

NO OPERATOR, OF COURSE, would suggest that lightning turn-arounds be practised as a matter of routine—particularly with new motorships. Quick turnarounds, like the one mentioned in the previous note are carried out only in cases of emergency, such as when a ship has been storm or fog delayed and has to make up her schedule. Some one suggested the other day that the motorship could never hope to turn around as quickly as the steamer. He granted that the motorship could bunker more quickly because she would have less fuel to take on board. But he contended that valves would have to be changed and all manner of jobs done in the engines. The owners of a large motor passenger liner in transatlantic trade inform us that they can, as far as the engines are concerned, turn the ship around in one hour—at any time and at the end of any given transatlantic voyage. They would not recommend doing such a thing regularly, of course, but it could be done if necessary. The ability for quick turnaround for motorships depends naturally in no small measure upon the ability of the operating crew. The big Swedish America motorliner GRIPSHOLM turned around in New York recently in 28 hours and during that time she took on board 10,000 bbl. of Diesel fuel—a greater amount than usual because on reaching Gothenburg she was scheduled for a Mediterranean cruise. The SVEALAND and AMERICALAND—20,600-ton motor ore carriers, operating between Cruz Grade in Chile and Baltimore, Md., or New York, spend periods in port at each end of a 19-day voyage ranging from 2 to 12 hours. All the overhauling necessary is done on alternate engines at sea when the ships are running light to Chile. These ships have maintained a most rigid schedule since commissioning in 1925. Many motor tankers make just as quick turnaround.

Where Is the Economy?

TURBO-ELECTRIC DRIVE is being fitted to the 19,000 ton passenger vessel building on the Clyde for the P. & O. Company, London. This type of propulsion—declared Lord Inchcape—is considered to show greater economy than other types of machinery of similar power. We wish his lordship had been less general in his statement. To what particular type of "economy" was he referring? Surely not to fuel economy, because as a glance at the first article in this issue will show no turbo-generating plant can ever hope to approach the economy of the Diesel plant however high the steam pressure, however great the superheat. The new P. & O. liner is designed for service between London and the Far East via the Suez Canal and the Red Sea. Her owners have never shown any great partiality towards the steam turbine—possibly because of the difficulty of maintaining a good vacuum in the Red Sea and other tropical waters through which their ships pass. Indeed, the P. & O. Company has been among the staunchest and most faithful adherents of the steam reciprocating engine and Scotch boiler. In short, they must have a most valuable collection of experience relating to the performance of big reciprocating prime movers on passenger ships which would very materially have aided them had they used Diesels. Such experience will be valueless as far as their new plant is concerned. We have shown elsewhere in this issue how a motorliner permits of clear deck spaces because it eliminates big, hot, boiler uptakes. This, we should have thought, is a matter of vital importance in the tropics. The discomfort experienced by those unfortunates who have had cabins near uptakes in the tropics is sufficient to drive any passenger into the arms of a motorship passenger agent. Economy, surely, is a many headed monster.

Ford to Convert Lake Type Freighter

WE recently made an announcement that the Ford Motor Company was considering converting a Lake type freighter to Diesel power for the purpose of carrying rubber to the United States from its newly established plantations in Brazil. Definite news of this contract is now to hand and work is to proceed on the vessel, we understand, with all speed at the Ford Company's own Fordson plant. This will enable the ship to be ready for operation when the lakes open for navigation again next spring.

We understand that the ship will be powered by a 1,000 hp. Busch-Sulzer Diesel, which will be fitted in the existing machinery space amidships. The LAKE ORMOC is one of a numerous class of ships built on the Great Lakes during the war. Although not of conventional lake type, i.e., machinery aft, bridge forward on the forecastle head, this class is known as lake-type freighters because in the first place they were built on the lakes, and in the second place their dimensions are such as to permit ships of the class to pass through the smallest lock of the Welland Canal system.

The Ford Motor Company already owns and maintains in commission one or two ships of this class, while they have, as is well known, bought and broken up at their River Rouge plant a large number. It is significant that the dimensions of the LAKE ORMOC, when she is converted to a motorship, will enable the Ford Company to bring rubber right from their plant on the Amazon River to their plant in Detroit without trans-shipment.

The Ford Company's outlook on marine matters is so free from conservatism and from a following of traditional practice that publication of details as to the conversion as soon as these are definitely settled will be eagerly awaited by all shipbuilders. Most of us remember the splendid work which was done on the EAST INDIAN; while the HENRY FORD II and the large motor Lake freighters which the Ford Company owns are classics in the shipbuilding art.

Characteristics of the Lake Ormoc

Length o.a.	261 ft. 0 in.
Length bp.	251 ft. 0 in.
Beam mld.	43 ft. 6 in.
Depth mld.	24 ft. 2½ in.
Displ. at load draft	5280 tons
Draft (load)	21 ft. 3 in.

The LAKE ORMOC at present has a total bale capacity of 161,413 cu. ft. or a total grain capacity of 157,467 cu. ft. She has a coal storage capacity of 247 tons and a reserve capacity of 266 tons. The space she requires for bunkers as a motorship will, of course, be much less. The 6-cylinder Busch-Sulzer Diesel rated for about 1000 b.hp. at about 165 r.p.m. is of single-acting, crosshead type with 17 in. cylinder bore by 27 in. stroke.

U. S. Shipping Legislation

Representative Will Wood of Indiana, recently introduced a bill before Congress which proposed to increase the provisions of the Shipping Board Loan Fund to 75 per cent. At present the Board can lend as much as 66 2/3 per cent to American shipowners who build in American yards. A further important step has been taken by the introduction into the Senate by Senator Copeland of a bill which proposes a revival of the Ocean Mail Act of 1891. The Copeland Bill provides for the carrying of mails on a contract basis in American vessels which may be converted into use by the Army and Navy in the event of emergency. Foreign mails are at present carried at the rate of $3 per mile. Under the new bill the rate would be $10 per mile. Both these measures are of a definitely constructive nature towards the construction of a U. S. Merchant Marine.

Ms. Bermuda—A Noteworthy Motorship

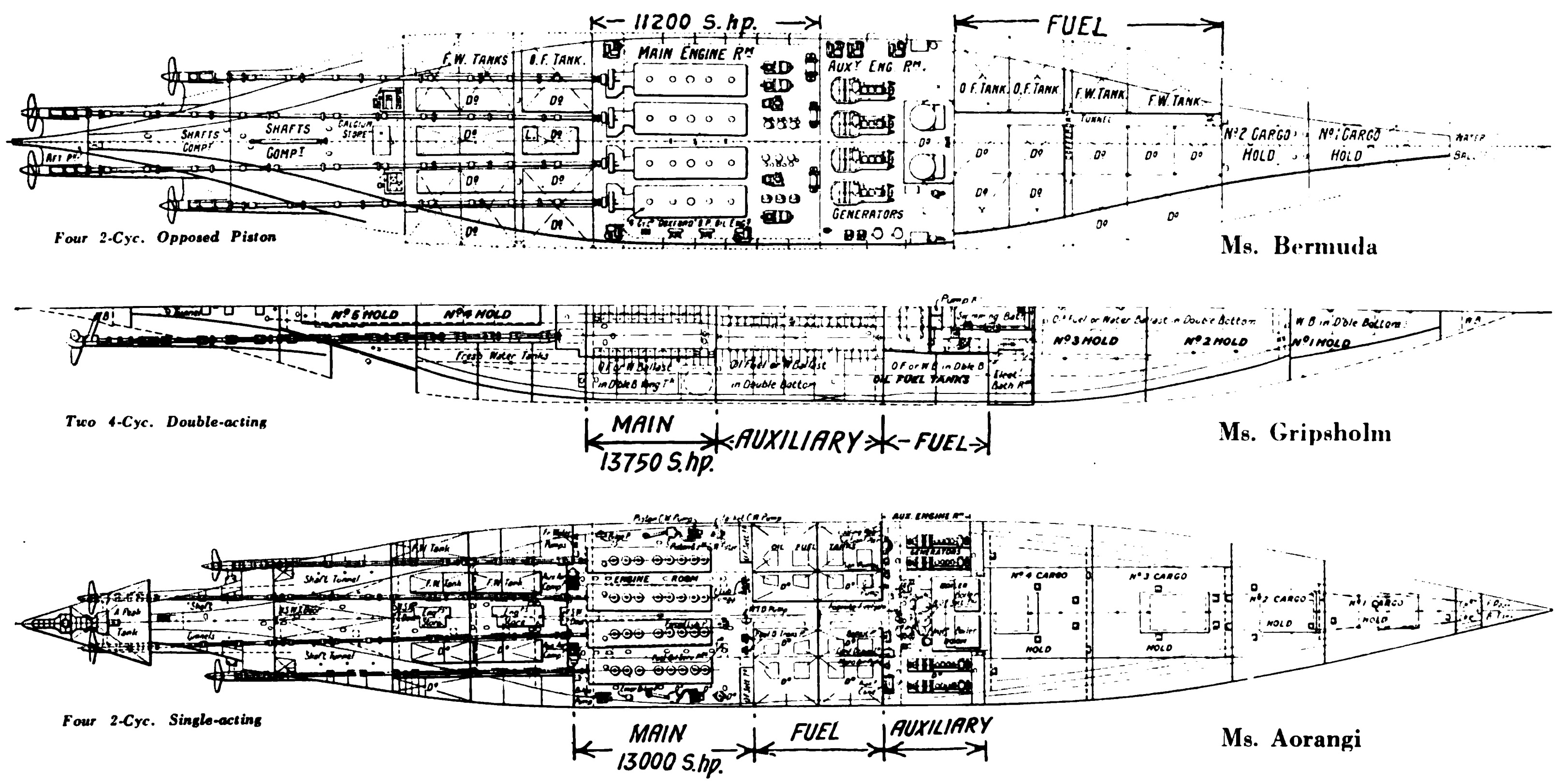
New Vessel, Proving Feasibility of Motorship for Short High Speed Runs, Makes Interesting Comparison with Aorangi and Gripsholm

THE new Furness motorliner BERMUDA takes her maiden sailing from New York on January 14. Apart from the fact that she is the first motorvessel of large size to be engaged on a short run with quick turn-around, her constructional features are such that they call for more than passing comment. Her designers have succeeded in taking full advantage of the increased deck space which Diesel layout permits her. This is well shown in the diagram reproduced opposite, which shows part of D-deck. The old steamer idea of having a large trunkway running up to the topmost deck surrounded by a skylight has been done away. Neither, of course, is there any necessity for space-eating boiler uptakes. Consequently, as low down in the ship as D-deck we find a large clear dining saloon with but two square trunkways, comparatively little more than ventilation trunks but actually exhaust trunks for auxiliary Diesels. Similarly in the galley spaces there are two slightly larger square trunkways whose purpose is to take the exhaust from the four main Doxford opposed-piston motors of special design.

Previous motorliners have shown a tendency to take advantage of the clear deck space which the Diesel permits, but our feeling is that never has this been realized to such an extent as on the BERMUDA. The machinery space itself, in spite of the fact that it contains four big opposed piston Diesels developing collectively 11,200 b.hp., is roomy. As was the case with the AORANGI in which a similarly neat layout was arranged, the controls for the main engines are at the forward end of the engines. This is perfectly logical in such an arrangement because it permits of ready access to all engines. The BERMUDA'S engineroom, as the plan of machinery spaces indicates, in contrast to the AORANGI'S engineroom layout has the auxiliary machinery in the next compartment. MS. AORANGI has fuel tanks between the main and auxiliary enginerooms and her auxiliary engineroom is somewhat cramped, because in it are two large Scotch boilers generating steam for the deck auxiliaries and some of the engineroom auxiliaries. The contrast between the two layouts is interesting because the ships are practically the same size.

MS. GRIPSHOLM'S arrangement may also be compared with that of the other two ships because here again the hull dimensions bear a similarity to one another. The main engineroom containing 13,750 s.hp. is wonderfully small as regards floor space, but as might be expected, it takes up more height than the main engine of either the AORANGI or the BERMUDA. This is due to the double acting Diesels.

The auxiliary engineroom of the GRIPSHOLM is larger than her main engineroom and larger than that of either the AORANGI or the BERMUDA. This is because Diesel engines driving injection air compressors and the generators are located in this room. MS. BERMUDA has airless injection of fuel and in consequence requires no injection air compressors. Three main maneuvering air compressors are located in the main

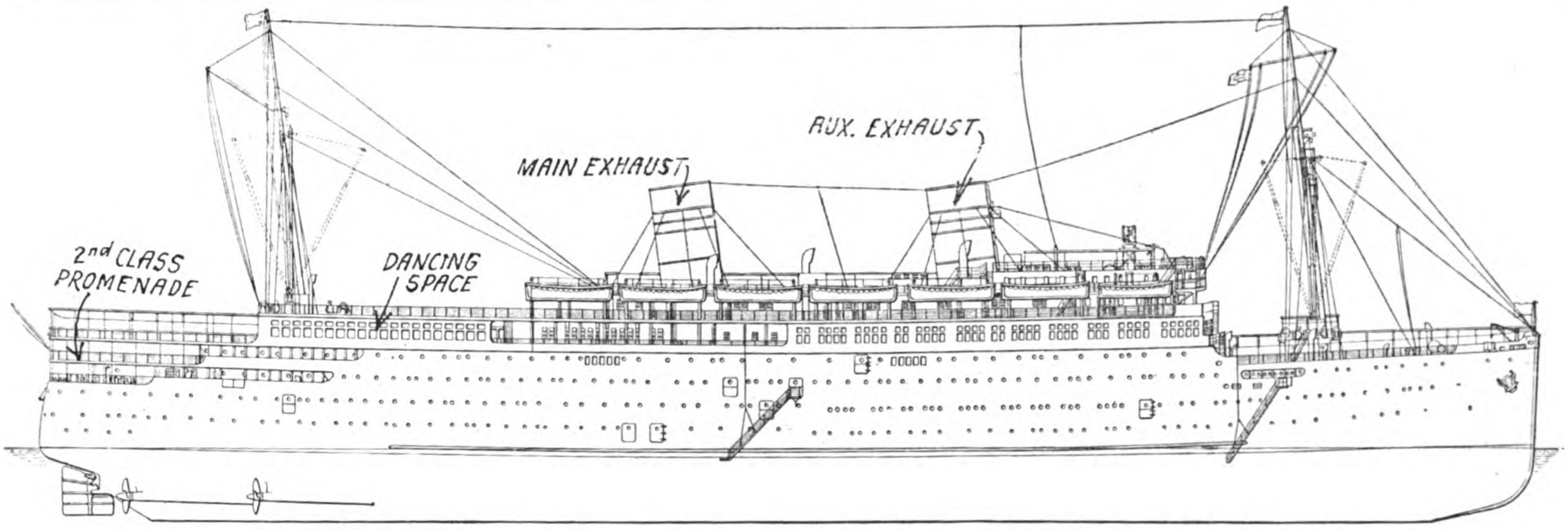


Motorliners Bermuda, Aorangi, and Gripsholm Compared

Name	Service	Reg. Dims. Ft. L.	B.	D.	Tonnage	No. of Pass.
Bermuda	New York-Bermuda	550.0	74.0	45.0	17,000 G.	691
Gripsholm	Gothenburg-New York	550.0	74.0	42.5	17,300 G.	1,617
Aorangi	Vancouver-Sydney	580.0	72.2	46.6	17,491 G.	1,000

Name	Total Power	Speed	No. of Engs.	Ins. Bore	Ins. Stroke	R.P.M.	Type	No. of Cyls.
Bermuda	17,300 G.	1,617	4	24.0	41.0 lower 24.0 upper	110	2-cyc. O. P.	4
Gripsholm	13,750 S	16	2	33.1	59.1	125	4-cyc. D. A.	6
Aorangi	13,000 S	17	4	27.5	39.0	127	2-cyc. S. A.	6

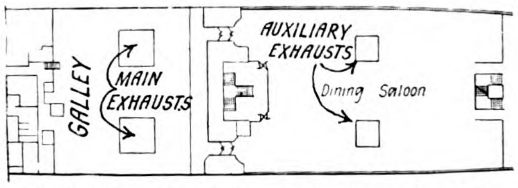
Three Interpretations of Powering in 11,000-14,000 Hp. Motor Passenger Liners



The outboard profile of the new Furness Bermuda liner Bermuda, upon examination, reveals many of the Diesel-born structural refinements which tend to make her one of the most luxurious passenger liners afloat. She has made 19 *knots with* 14,500 *b.hp.*

engineroom just forward of the main engine controls. The big Doxford engines drive their own scavenge pumps. The AORANGI'S engines drive their own injection air compressors but scavenging is taken care of by rotary blowers. Much credit must be given to the designers of the BERMUDA'S engine for having produced a remarkably compact engine and for having kept the height down to within very reasonable limits. This has been done by making the stroke of the upper piston smaller than that of the lower piston.

Returning now to the general arrangement of the BERMUDA, we find that each of the two stacks takes exhaust, the forward one from the auxiliary engine and the aft one from the main engines. The vessel stands high out of the water and presents quite a solid looking profile. The cargo

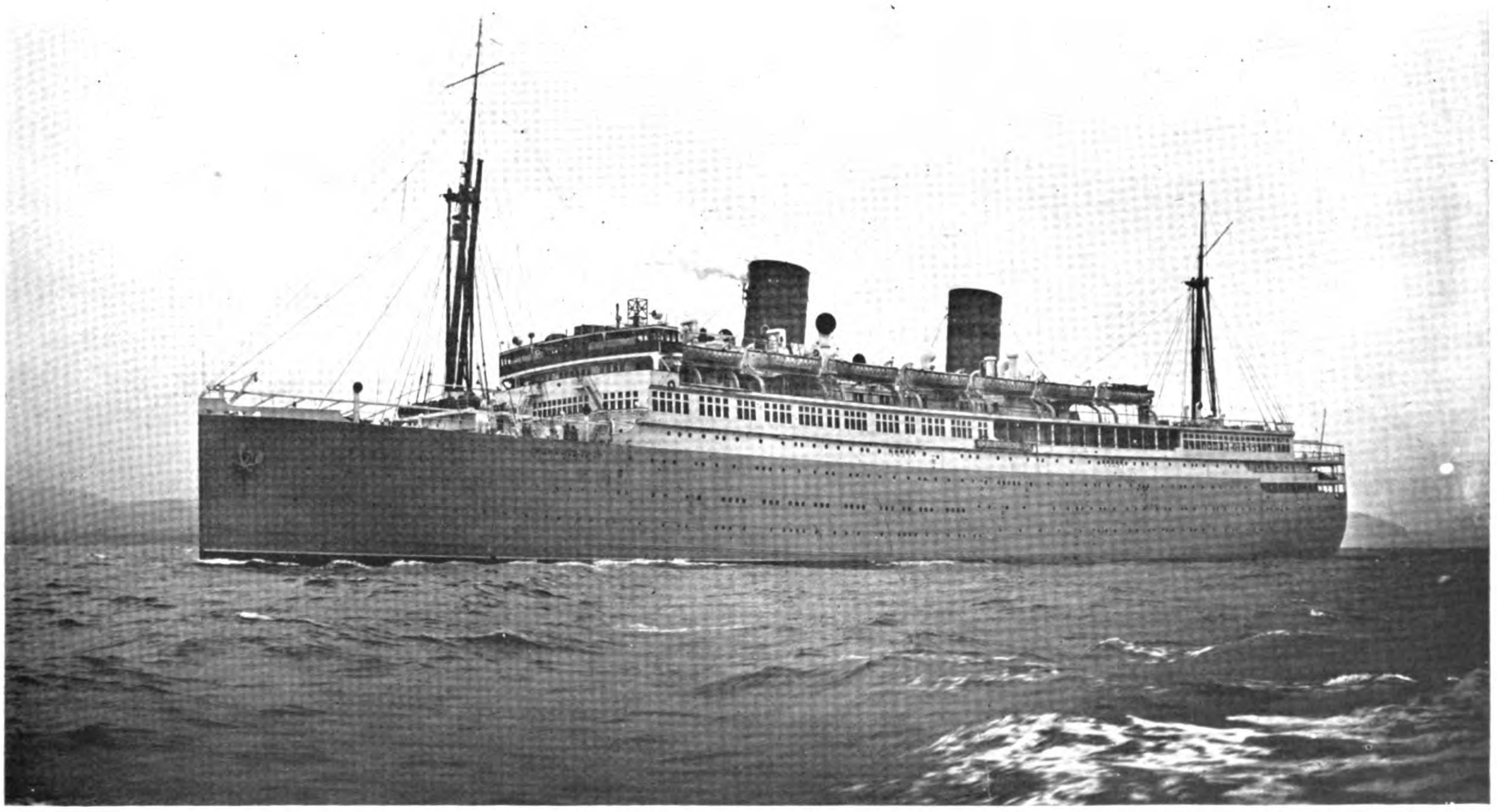


This is the only visible indication of machinery on D deck of the Motorliner Bermuda

handling gear, which is naturally quite adequate for all the cargo carrying the ship will have to perform, is very neatly disguised. There are actually only three small cargo hatches, all served by electric winches. A noteworthy feature is the large glass enclosed dancing space on A-deck.

It is specially noteworthy that there are large areas of enclosed, and therefore comfortable promenading spaces. The big glass enclosed dancing space aft is quite a novelty and reflects modern thought in passenger carrier design.

The vessel's undoubted fuel economy over corresponding steamers should make her extremely cheap to operate and the fact that she is running on short distance run with a quick turn around should very definitely demonstrate that it is not only for long haul service that the motorship



Ms. Bermuda running speed trials in Belfast, Lough. She is propelled by four 4-*cylinder Doxford opposed piston Diesels of* 11,200 *collective b.hp.*

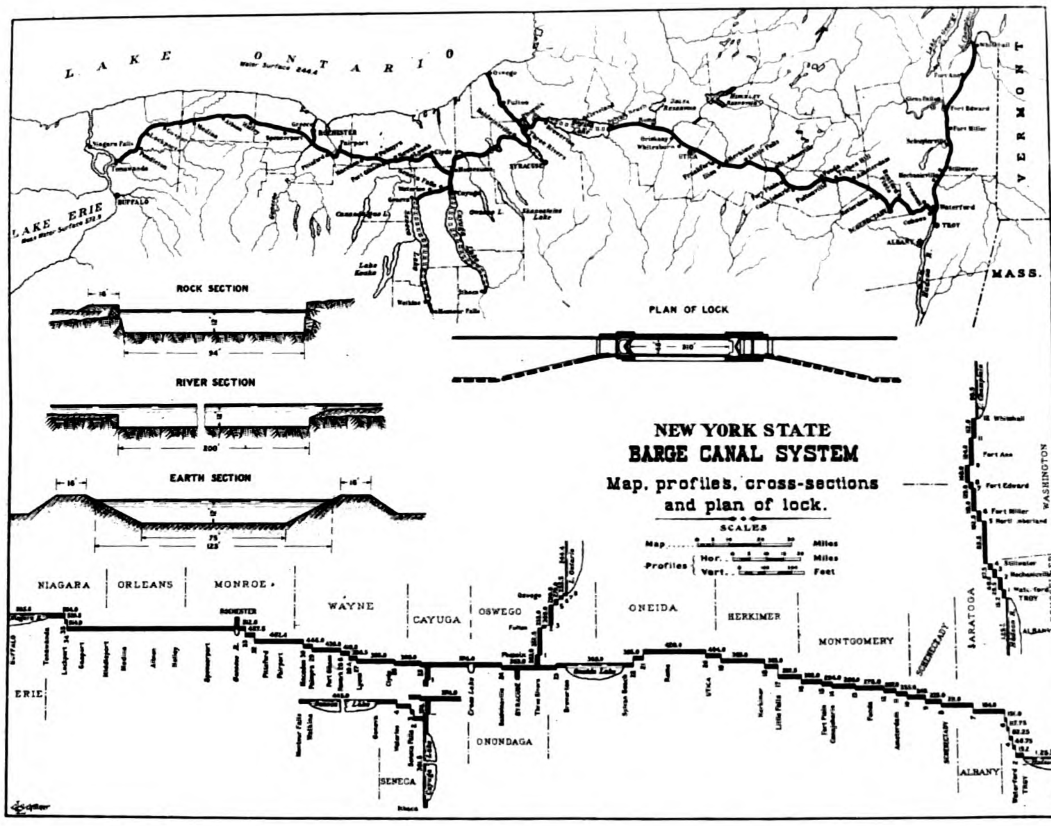
Motorshipping and the N. Y. Barge Canal

Owners and Operators Now Realize the Advantage of the Diesel Engined Ships for Inland Waterway Transportation

THE important part played by the New York State Barge Canal in the vast scheme of inland waterway transportation which belongs particularly to the United States is not always realized. Neither is it adequately recognized that recent improvements in the instruments of transportation used on this waterway have been due in no small measure to the Diesel engined ship.

In order to point out the advantages of using the New York State Canal system which ranks among the foremost in the world as an engineering achievement and as a transportation medium, and which is moreover free from tolls, Frederic Stuart Greene and Thomas F. Farrell, Superintendent of Public Works of the State of New York and Commissioner of Canals and Waterways respectively, have prepared a descriptive booklet full of important data as to the potentialties of the Canal. This booklet, which may be obtained from the State Public Works Building, Albany, N. Y., is profusely illustrated and as an addition to contemporary literature on waterborne trade is important.

The canal is actually the only all-American water connection between the Great Lakes and the sea. It is the artificial outlet from the Great Lakes to the Atlantic Ocean via the Hudson River. According to Mr. Farrell, in a statement which he has been good enough to prepare for MOTORSHIP, motorships have used the canal for 7 years.



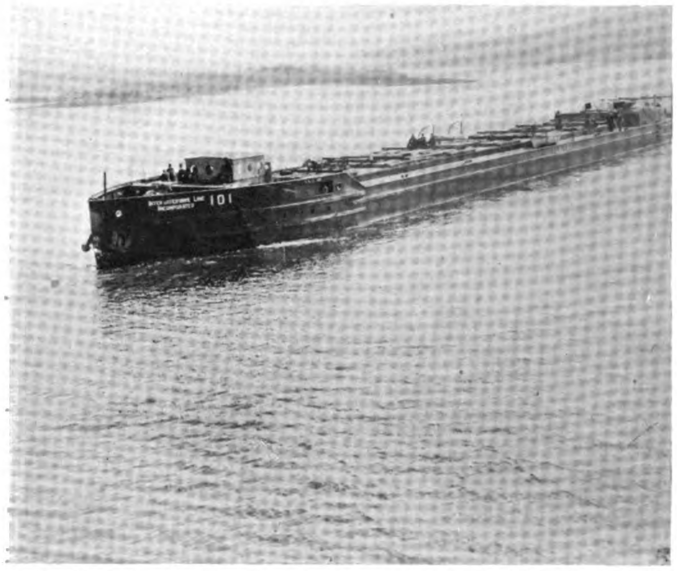
The first use of the improved State canals by motorships was in the year 1921. These vessels were considered by many as the first boats of sufficient size to test the adequacy of the canal. The first vessel of this type entering canal waters was the I. L. I. No. 101, which cleared from Buffalo, N. Y., on June 9, 1921, with a cargo of 83,000 bushels of oats (1328 net tons), for New York City. This was one of a fleet of five, known as I. L. I. Nos. 101 to 105, inclusive, especially designed and equipped steel cargo boats, built by the MacDougall-Duluth Shipbuilding Company, at Duluth, Minn., and operated by the Interwaterways Line, Inc., of New York.

These five boats, each equipped with two 140 hp. surface igniting oil engines and twin screws, 242.6 ft. long and 36.1 ft. beam, have cargo capacities of 1500 long tons on a 10 ft. draft and 1750 long tons on 11-ft. draft. Each of these boats originally left Duluth under load with grain for New York via the Great Lakes and canal but since their initial trips they have been used in New York State Canal service and in service between Buffalo and Montreal, Canada, via the St. Lawrence river, lately being under the ownership of the Erie & St. Lawrence Corporation—for bulk carrying.

In 1923, two motorships, still larger than these above described, were placed in combined Great Lakes-and-Canal service by the Minnesota-Atlantic Transit Company, of Duluth. These vessels, the TWIN CITIES and TWIN PORTS, are 258 ft. long, 42 ft. beam, and 15.7 ft. from keel to deck, with a carry-

Ms. Sunoco, a coastwise and canal bulk oil freighter with two 360 hp. Bessemer Diesels

Ms. Amsterdam Socony, a similar ship with two 350 hp. McIntosh & Seymour Diesels



Ms. I. L. I. No. 101 was one of the first motorships to use the State Barge Canal

Ms. Twin Cities is a Diesel-electric canal freighter with two Lombard Diesels and a 750 hp. G. E. motor

ing capacity of 2000 tons on canal draft, or 2600 tons on draft, permissible on the Great Lakes. The propelling machinery consists of two 6-cylinder Lombard Diesel engines coupled to 250 kilowatt General Electric generators, whose current is carried to 250 horsepower G. E. electric motors, one on each shaft. These boats are equipped to give refrigerator service to approximately one-third of their cargo and were particularly designed for package freight service between Duluth and New York City, with coastwise use during the period of closed navigation on the lakes and canal.

Oranges have been transported by this line from Florida to New York. During the season of 1927, these two vessels have maintained a scheduled service between New York and Detroit, Michigan, under management of the Detroit-New York Transit Company. There is also a fleet of Nelseco engined tugs in operation.

There will probably always be—says Mr. Farrell—those who believe the barge type canal boats, either of wood or steel, operated in fleets of four to six vessels, the ideal canal cargo carrier. Others consider the individual-self-propelled unit the preferable type of canal vessel, due to its greater speed and ability to navigate waters on which fleets of canal boats are difficult to control.

Diesel engined vessels are economical in operation and when power is not required, for temporary periods, no fuel.

The Detroit-New York Transit Company boats are making the trip between Detroit and New York in about five days and the New York State Canal portion of the trip between Oswego and Troy, 187 miles with 30 locks, in about two days. Cargoes of as high as 54,000 bushels of eastbound grain are reported, also shipments of export automobiles and Pacific Coast canned goods destined to interior ports.

Modern Diesel canal tug De Witt Clinton

Old style steam tug on Lake Oneida

A New Claiborne–Annapolis Ferry

THE big Diesel driven ferryboat GOV. ALBERT C. RITCHIE—a converted steamer which has been successfully operating heavy automobile traffic between Claiborne and Annapolis, Md.—is to be joined by an all steel ship slightly larger and in all respects more up to date. The decision of the owners in this matter has unquestionably been taken as a result of the economical service which their existing motorship has given them.

The new ship will be in all respects more powerful than the existing ship, a total of 1,600 hp. being given by two 800 hp. Fairbanks-Morse Diesels. The original vessel had two 360 hp. units.

The vessel is to be of double ended single deck type with a steel deck house on main deck and a social room on top of deck house. There will be pilot house, officers' quarters, and dining room above. The ship is to be built on the transverse system of construction. Propelling machinery is to be located amidships with one propeller at each end.

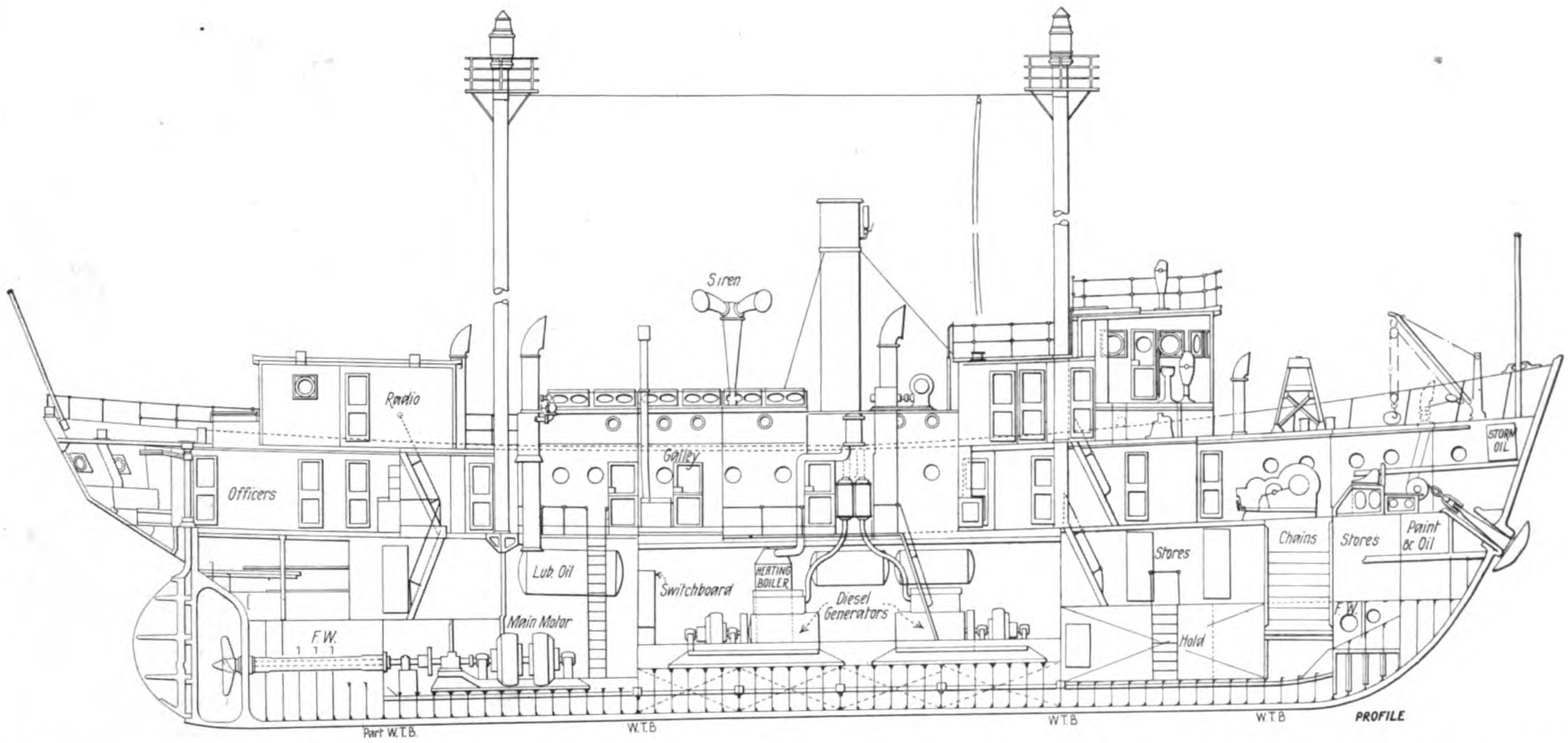
The vessel will be built according to drawings and specifications and to highest class of American Bureau for Ferry Service. The equipment is to be in accordance with American Bureau requirements, steel material to be as required by class.

The boat has been designed by A. J. C. Robertson, Naval Architect, and is of the following dimensions:

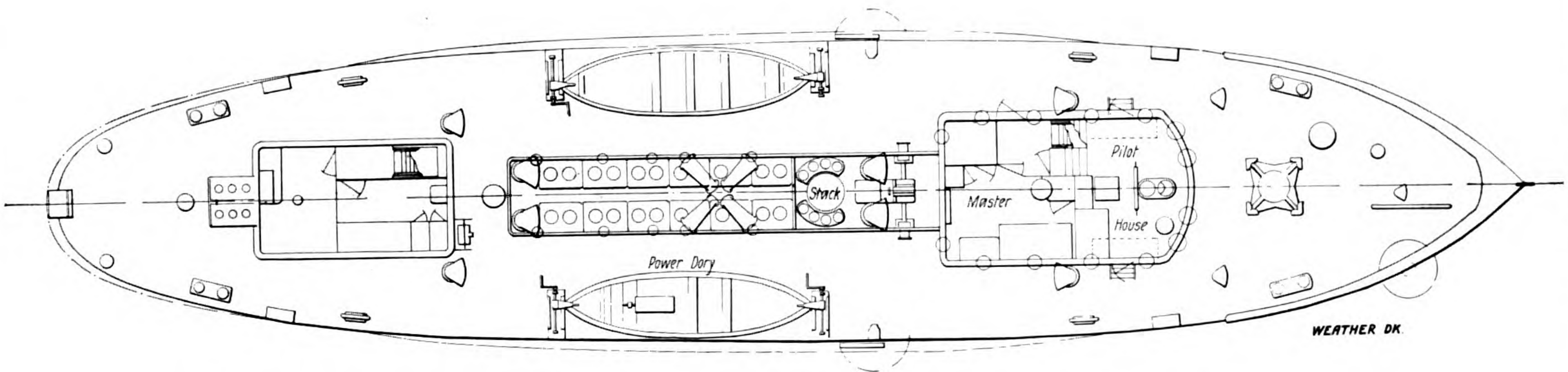
Length overall ....220 ft.
Length b. p. ....198 ft.
Beam molded ....60 ft.
Depth molded ....14 ft. 6 in.

The equipment will include F.M. generating and compressor sets, two Sharples centrifuges and the usual pump equipment. Spear Engineers, Inc., Norfolk, Va., are the builders. We hope to publish further details in a future issue.

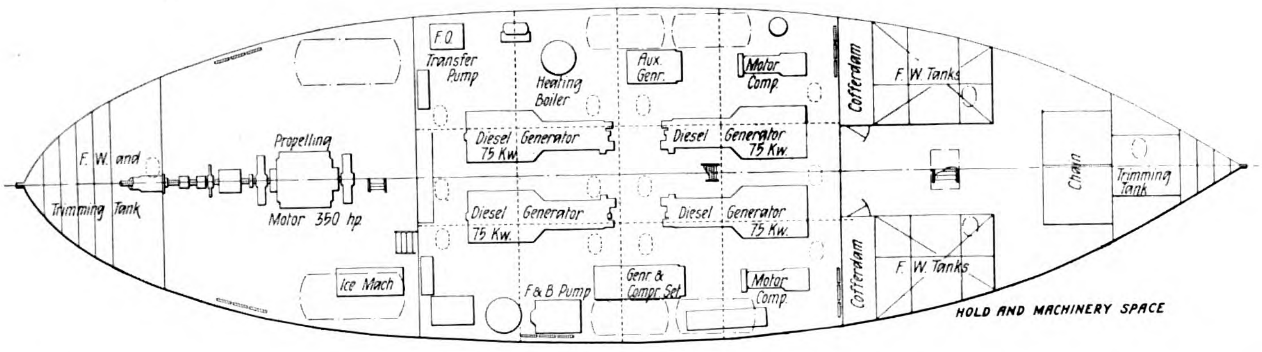
Proposed Diesel-Electric Lightships



Inboard profile of new Diesel-electric lightship of No. 100 class shows conventional lightship hull. Note especially the compact machinery space



Plan view of weather deck of the new lightships shows the excessive tumble home characteristic of such craft



Hold plan shows the machinery layout with four Diesel generator sets in a main engine room and a 350 hp. propelling motor in a special compartment

New U. S. Diesel-electric Lightships

Details of New Vessels with Four Diesel Generators Furnishing Power to All Mechanical Apparatus on the Ship

WE pointed out on the occasion of the commissioning of the first U. S. Diesel-driven lightship early last year that Diesel-electric drive was probably a more economical form of lightship powering than straight Diesel drive—although, of course, both are far more economical than steam drive.

Details of the design, upon which bids were called recently, reveal the fact that a great deal of careful thought has been given by the Bureau of Lighthouses towards the production of a thoroughly up to date ship.

The vessel will be constructed of steel, and, where practicable, other fireproof materials. It will have a continuous sheer line, a curved stem, an overhanging stern, a continuous upper deck, a forward steel pilot and deck house containing the master's quarters, inclosed passageway to the crew's space, etc.; an afterdeck house containing the radio apparatus, quarters for its operators, and a passage to give access to the main deck below. There will be steel skylights and trunks, two tubular steel lantern masts with lanterns for the characteristic lights, a mainsail, and a forestaysail, exhaust-pipe casing, and trunk with a mechanically operated fog-signal apparatus and a running whistle, an electric-lighting system, an electric-driven hoist for the boats and cargo, boats, anchors, davits, a fog bell. ventilators, etc.

The hull proper has a continuous steel main deck, a water-tight lower deck forward and aft of the machinery spaces, transverse and longitudinal watertight and non watertight bulkheads. The hold below the main deck is subdivided to form the forward trimming tank and collision compartments, chain lockers, general storage holds and storerooms, the structural fresh-water and fuel-oil inner bottom tanks, and machinery spaces. The compartment inclosing the hawse pipes and forming the breakwater is arranged with a tank to contain and distribute storm oil for use in severe weather.

The main propelling machinery consists of four vertical four-cylinder Diesel generating sets of 75 kw. capacity, arranged to drive a 350 s.hp. double armature motor direct connected to the propeller shaft.

Characteristics of New Lightship

Length o.a. (molded)	133 ft. 3 in.
Length on l.w.l	108 ft. 9 in.
Beam molded	30 ft. 0 in.
Depth at side (midship)	15 ft. 0 in.
Displacement	630 tons
Draft at above	11 ft. 9 in. fwd. 13 ft. 3 in. af.t
Main motor power	350 r.p.m.

The principal auxiliary machinery consists of two 7½-kw. full Diesel direct-connected generating sets, one motor-driven fire, deck, and bilge pump, one motor-driven transfer pump for fuel oil, one air-driven fresh-water pump, one high-pressure air compressor connected to one of the auxiliary generating sets, two motor-driven low-pressure air compressors for fog signal, one motor-driven windlass, one motor-driven boat hoister, one hand steering gear, one motor-driven refrigerating plant, one air-driven fog-signal-control apparatus, one oil-burning vertical tubular heating or donkey boiler, and the usual smaller pumps, and devices for the fuel-oil system, etc.

The vessel has a spare tiller and gear at the upper deck, air ports, cleats, fairleads, chocks, and rigging, etc. The outfit and equipment include two Navy-standard compensating binnacles and compasses, blocks, kedge anchor, anchor and chain-handling gear; boats; anchor, boat and cargo davits; fog signal and running whistles, ship light, running lights, two repeating mechanical-engine telegraphs, speaking tubes, bells and pulls, ventilators, fire and drainage system and scuppers, hot and cold water plumbing with sinks, lavatories, bathtubs, shower, and water-closets; air ports, deck and fixed lights, doors, hatches, scuttles, ladders, gratings, handrails, stanchions, grab rods, eyebolts and pads, ring life buoys, shelves, lockers, built-in furniture with drawers and accessories.

Each main generator is direct connected to a 112-b.hp. Diesel, running at 450 r.p.m. The engine specifications require that the governor will regulate engine speed within 3 per cent of normal from no load to full load, and will maintain any desired speed between 75 per cent and 100 per cent of normal full speed.

The generators will be of the open, direct-current type flat compound, wound for auxiliary power and shunt wound for propulsion. Each generator will develop 75 kw. at 125 volts and 450 r.p.m. Full power is not contemplated for speeds below 450 r.p.m.

The main motor will be direct connected to the main shaft for driving the propeller. It will be of the open, direct-current, shunt-wound, double-armature type, separately excited from the 125-volt excitation bus. It will develop 350 b.hp. with both armatures in series, at 300 r.p.m.

Diesel Engined Fruit Carrier

MS. PELAYO, the second of five motorships ordered from Harland and Wolff, Limited, Govan, by MacAndrews & Co., Ltd., for their Liverpool-Mediterranean fruit trade, is of shelter deck type built to Lloyd's "100 A.1. Class" requirements, the dimensions being 270-ft. length b.p., 39-ft. breadth molded and 17-ft. 6-in. depth to upper deck, with a gross tonnage of 1345. There are two complete steel decks as well as boat deck and navigating bridge. Five watertight bulkheads extending to the shelter deck divide the vessel into three cargo holds, motor room and fore and after peaks. The holds are fitted with cargo hatches of ample size, and are worked by six derricks attached to two steel pole masts, each derrick being suitable for 5-ton lifts. The propelling machinery consists of a 6-cylinder single-acting Harland-B. & W. motor, which will give the vessel a speed of over 12 knots loaded.

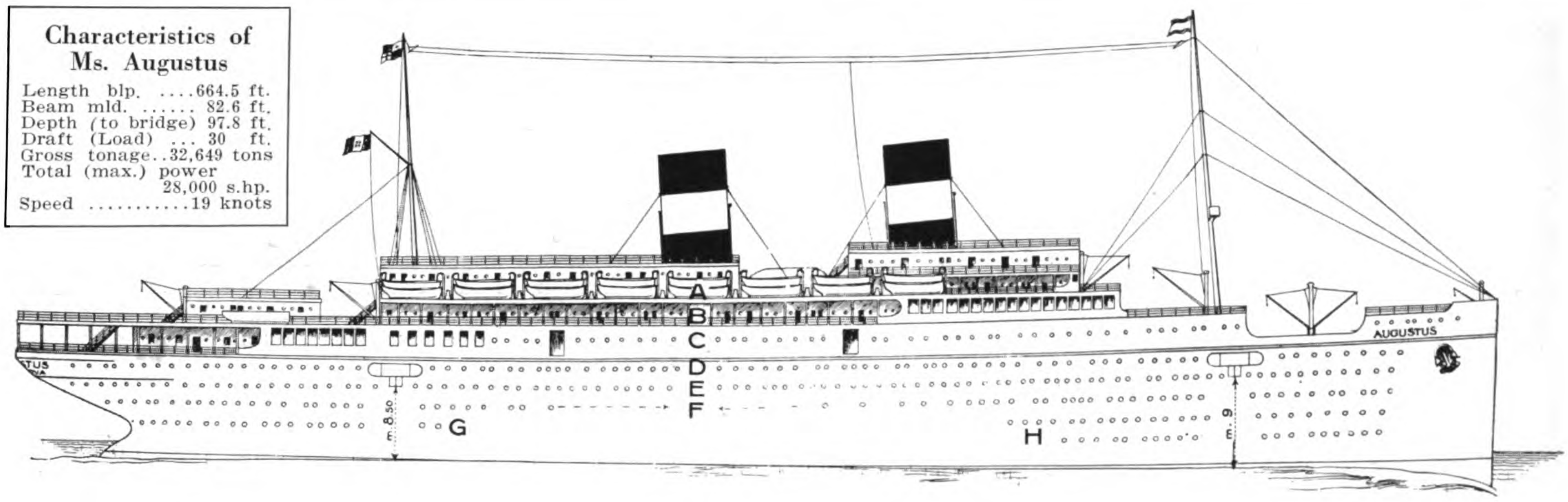
Ms. Pelayo, a 1345-ton gross motor freighter, is the type of motorship with an American coastwise application for short haul services

Bath Ironworks Reopens with Diesel Yacht

Announcement of a general revival of shipbuilding at the plant of the famous Bath Iron Works in Bath, Maine, has created widespread interest. After 2 years of inactivity the plant has been taken over by a new corporation headed by William S. Newell as President and general manager. The first contract has been obtained—an order for a twin screw steel motoryacht, propelled by two 1500 hp. Bessemer Diesels.

Characteristics of Ms. Augustus

Length blp. ....664.5 ft.
Beam mld. ...... 82.6 ft.
Depth (to bridge) 97.8 ft.
Draft (Load) ... 30 ft.
Gross tonage..32,649 tons
Total (max.) power 28,000 s.hp.
Speed ....19 knots



The Italian Motorliner Augustus

Big 19 Knot Ship with 25,000 Hp. Double-acting 2-Cycle Diesels Now in N. G. I. Genoa-S. America Trade

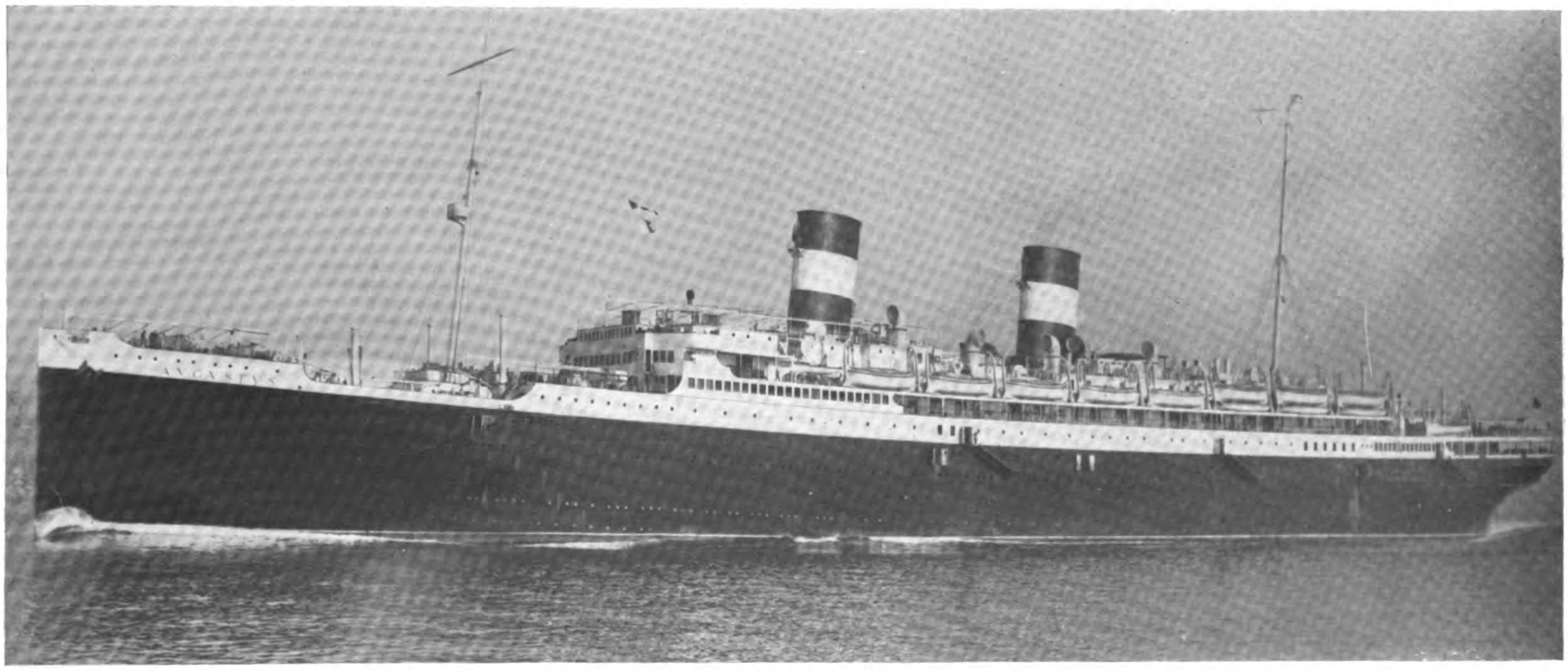
MS. AUGUSTUS is at present the highest powered passenger motorliner in the world. She has been built at Genoa by the Ansaldo Co. at their Sestri Ponente works, and is now operating between that port and South America. Like most recent products of Italian shipbuilders' art, her general equipment and interior decorations are luxurious to a degree and include a special sports deck with tennis courts, special de luxe cabins and other features. Ms. AUGUSTUS has a designed service speed of about 19 knots, this speed being given by four double-acting, 2-cycle M.A.N. Diesels, developing collectively about 25,000 s.hp. These engines do not drive their own scavenge pumps, there being three large electrically driven scavenge blowers taking current from Diesel generating sets in an auxiliary engineroom for this purpose.

The auxiliary requirements on this ship are heavy and are taken care of by eight Diesel-driven generators, five of which are 300 kw. machines each coupled to a 600 hp. at 300 r.p.m. M.A.N. 4-cycle Diesel. The remaining three sets are of 600 kw. output at 215 r.p.m., each of these being coupled to a 1200 i.hp. Diesel. These three units supply the current to the scavenge blowers.

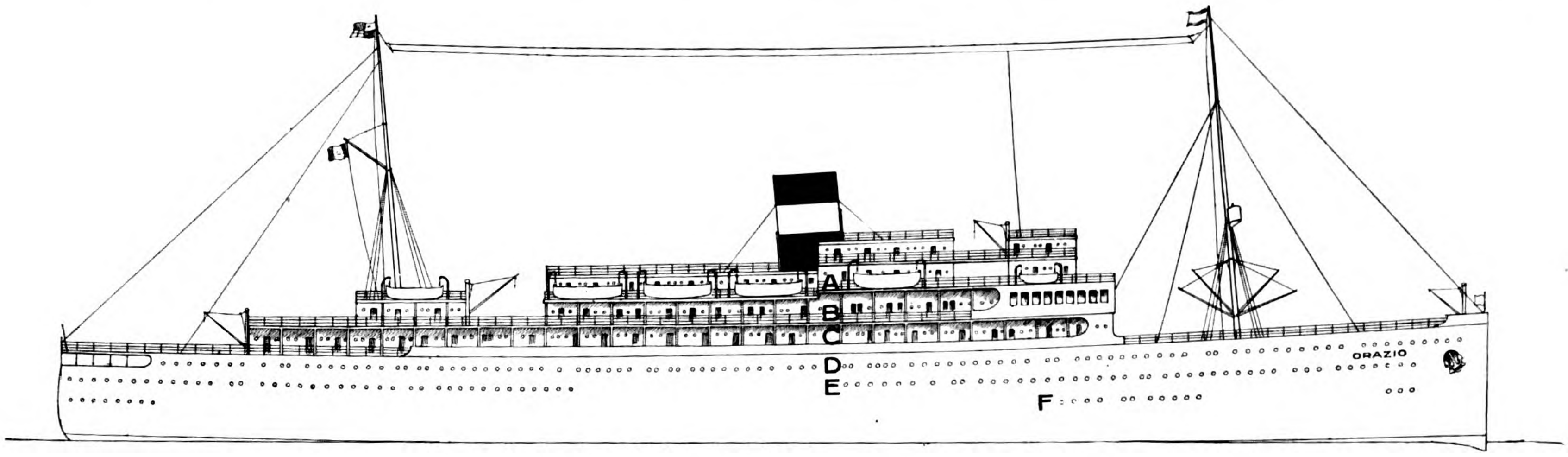
The AUGUSTUS is a Diesel-driven duplicate of the turbine-driven ROMA completed recently for the Navigazione Generale Italiana and running between Genoa and New York. She has seven decks devoted to passenger accommodation and public rooms, and in this space is accommodation for 300 first-class, 200 second class, 300 "economic" second-class and 1400 third-class passengers, making a total of 2200 passengers in all. Most of the third-class passengers are accommodated in two, four and six-berth cabins, some 400 of the 1400 occupying open-berth sleeping quarters. The crew comprises 500, and the total company of the ship is thus 2700 people.

There is on the sports deck an open air swimming bath. The gymnasium extends across the forward end of this deck with promenade space aft. A-deck, or the boat deck, has a continuous promenade space around all four sides while the winter garden, first-class smoking room and reading room are at the aft end of this deck. An enclosed veranda, the social hall and a large tea room are also arranged on this deck, while a nursery is provided on the port side. At the after end of B-deck is the second-class smoking room, which has large promenade space around it. C-deck is larger, occupied by first-class cabins, these including a number of special suites with private bathroom and sitting room. Second-class dining room is at the aft end of C-deck, passenger accommodation occupies most of B-deck, while the "economic" dining room is at the forward end of this deck, and the third-class aft. A certain number of single and 2-berth cabins are located on E and F decks.

The profile view shown above gives an idea of the graceful appearance of the ship. She is one of the noteworthy 1927 ships.



The Italian motorliner Augustus has four screws each driven by a 6-cylinder double-acting 2-cycle M. A. N. Diesel. She has a sea speed of 19 knots



The Italian Motorliner Orazio

One of Two 14-Knot Ships with 6600 Hp. Single Acting 4-Cycle Diesels for N. G. I. Genoa-Valparaiso Service

THE Italian motorliner ORAZIO, owned and operated by the Navigazione Generale Italiana, transited the Panama Canal on November 19, 1927, on her maiden voyage, enroute from Genoa, Italy to Valparaiso, Chile. Ms. ORAZIO is a passenger and freight vessel of 11,920 tons gross and carries a crew of 258 men. At the time of transit there were 316 passengers and 1283 tons of cargo on board for South American ports. The motorship VIRGILIO, of the same company, a sister-ship of the ORAZIO, was completed recently and will be placed in service this year. The two vessels have been assigned to regular service between the Mediterranean and the west coast of South America.

They are fine examples of the modern motor liners and have been engined by the Stabilimento Tecnico Triestino, Trieste, Italy. Two B. & W. type engines are installed each with 8 cylinders 29 in. bore and a piston stroke of 59 in., giving a normal output of 4,400 i.hp. or 3300 b.hp. at 120 to 125 r.p.m. when supercharged. There are three 3-cylinder Diesels of 250 b.hp. each coupled to a generator, and a fourth unit develops 600 i.hp. and is coupled to a generator with an output of 280 kw.

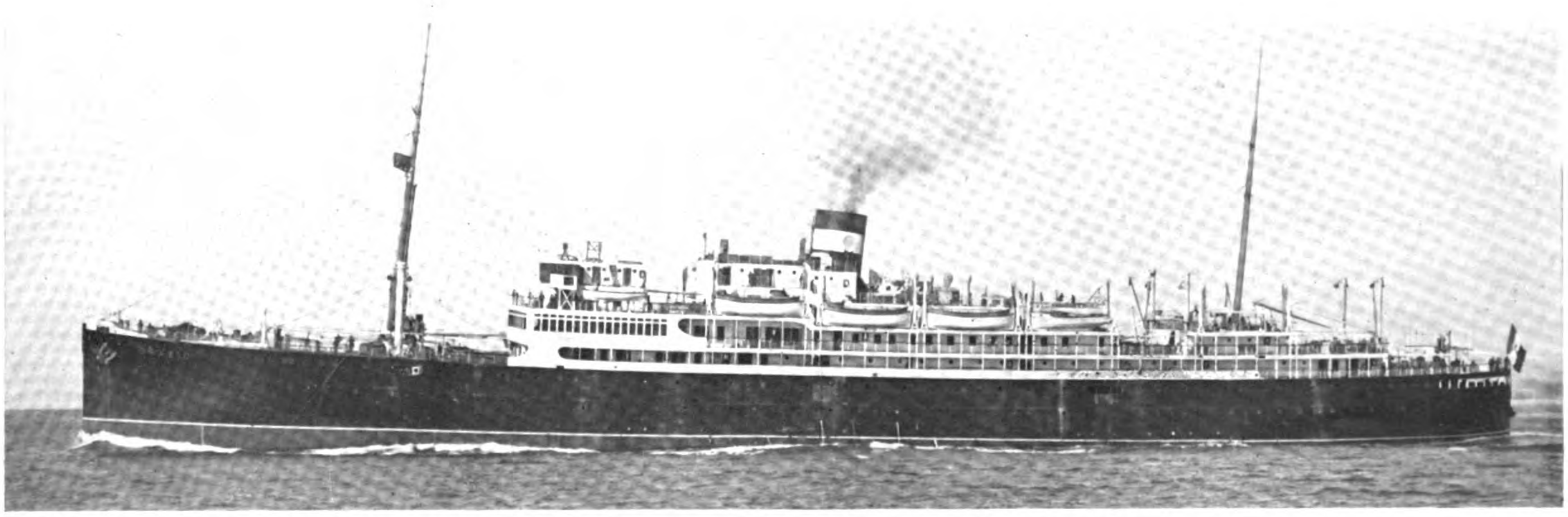
The five cargo holds have a total capacity of about 7800 tons, and refrigerated space amounting to approximately 6300 cu. ft. is available for the carriage of food, fresh fruit and meat. Very excellent passenger accommodation has been fitted and there are quarters for 110 first-class, 190 second-class and 340 third-class passengers. Included in these quarters are a number of special features including a ballroom, as well as a swimming pool, in addition to the usual public saloons, dining-room, smoking-room and veranda café. A certain number of cabins-de-luxe is included in the accommodation, and a good proportion of the first-class cabins have single berths.

Characteristics of Ms. Orazio	
Length o.a.	503.3 ft.
Length bp.	480 ft.
Beam mld.	62 ft.
Gross tonnage	11,920 tons
Displacement	16,880 tons
Deadweight capacity	7,800 tons
Power	8,800 i.hp.
Service speed	14 kts.

We may regard the sister motorship ORAZIO and VIRGILIO as forerunners of a number of vessels for services of this nature. Again, in the services for which these ships are intended, the Panama Canal comes into the picture. These vessels will connect Genoa with ports on the west coast of South America terminating at Valparaiso.

The West Coast of S. America will, as a matter of fact, shortly become well acquainted with motorshipping. In April of this year the first of two new Grace motorliners will constitute a motorshipping link with New York. In size and power the ORAZIO and VIRGILIO compare from a dimensional and a capacity point of view with these ships. They are, in hull dimensions, 480 ft. x 62 ft. x 11,920 gross tons. The new Grace liners are 486.5 ft. x 64 ft. x 9000 gross tons. The Italian vessels carry 110 first class, 190 second class and 340 third class passengers. The Grace liners carry 157 first class passengers.

All four ships—the two Italian ships and the two American ships—mark important steps in motorshipping development.



The Italian motorliner Orazio has two screws each driven by an 8-cylinder single-acting B. & W. Diesel. She has a sea speed of about 14 knots

A New 4-cycle Compressorless Oil Engine*

Its Characteristics and Potentialities with Special Reference to the Hesselman Combustion Chamber, and Membrane Fuel Valve

THE successful design of any heavy oil engine necessitates efficiency of fuel-air mixture. In air-injection engines success was rapidly obtained, but with the more recently introduced airless-injection design the uniform realization of an efficient mixture is not yet so clearly evident. Progress has uniformly developed along lines directed towards the use of higher fuel injection pressures, but for a clearer understanding of the problem, however, it is essential to investigate the physical properties of a fuel spray. Fortunately some recent work of Beardsley and Millar† is of assistance in this connection. Fig. 1 taken from their work, shows clearly the form of a fuel spray in a compressed nitrogen atmosphere.

In design work it is of importance to know the penetrative extent of a spray injected under a given pressure into an air atmosphere of known density. This involves a knowledge of the average magnitude of the fuel particle —a point which has been investigated by several workers using various means of experiment—together with further information of the frictional resistance of the air medium. On this latter point, investigators are far from agreement. A simple mathematical expression can however be set up involving the mass of the particle and its frictional resistance for given initial velocity, which, presented in the form of a differential equation for motion in a resisting motion, admits of an expression giving the distance traveled by the particle in given time being established. This distance gives the penetrability of the spray and is some guide to the practitioner. Beardsley and Millar's work shows that penetratability increases with injection pressure and velocity. Further, larger nozzle holes are known to have the same effect, two facts which can be deduced from theoretical investigation.

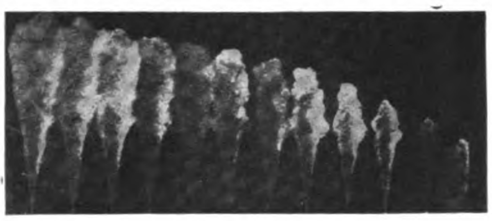


Fig. 1

A study of Fig. 1 in the light of various well known forms of combustion chamber directs attention to the Hesselman design shown in Fig. 2. This is clearly adapted to the nature of the spray and by the relatively short transverse penetratibility of the spray necessary, a relatively low injection pressure is fully efficient, a fact of major importance in large engines. However, the diameter of the spray, as is evident from Fig. 1, being relatively small, it follows that completely to fill the combustion chamber the combustion air must be given a certain rotation. This is accomplished in the Hesselman design by having a five-spray fuel nozzle and covering the air inlet valve by a rotatable cap which directs the air in a rotatory direction as is illustrated in Fig. 3. The holes in the fuel nozzle are slightly chamfered on their inner edge thus ensuring a streamline flow through the length of the hole and a coefficient of discharge, which, after tests covering several thousand hours, shows no sign of reduction from a steady value of 80 per cent.

A further feature of the engine is the adoption of a membrane fuel valve instead of the usual needle valve. The valve is illustrated in Fig. 4. The seat *a* and the head *b* are made of specially hardened steel. The valve head is loaded by the initially stressed membrane plates *c* superimposed upon the ground collars *d*. The centering rings *e* prevent relative movement of the membrane plates. The ring-space in each of these plates is filled with the cut ring pieces *g* clamped by the spring rings *f* to reduce the oil content of the valve. The membrane plates are further held together by the liner *h*, the whole set being removable in one. The air exhaust holes *i* allow of any air bubbles being withdrawn through the air exhaust valve *k*. The valve is in a wrought iron casing *e*. The fuel enters at *s*, passes through the ring spaces between *l* and *h* into the space *m* below the valve head *b* and lifts this against the membrane tension. The fuel then passes through the ring formed valve seat into the channel *n* and out through the nozzle holes *o*. The membrane tension, and hence the pressure exerted by the valve head *b* upon the seat *a*, is regulated by screwing down the thrust screw *p* on to the compression piece *q*. A stuffing box *r*, whilst admitting of the movement of the piece *q* in case of adjustment has the advantage over the needle valve of merely securing the tightness of two stationary parts and thus the possibility of valve seizing does not exist. The valve can be easily removed for cleaning and replaced in a much quicker time than for example is required for the installing of an ordinary fuel valve needle.

The stroke of the valve is exceedingly small and only of the order of 1/10 mm. in a 100 b.hp. cylinder. The valve thus closes very rapidly, does not vibrate or hunt and does not strain the valve seat.

Another feature of the compressorless engine which requires careful design owing to the smallness of the fuel nozzle holes is the filtration of the oil fuel. In addition to the usual pre-filtration, the Hesselman engine has a further filter installed between the fuel pump and fuel valve. This is illustrated in Fig. 5. It consists of a wrought iron chamber bored out to take the pins *a* with a slack fit. These pins are grooved along their length, alternative grooves b_1 starting from the bottom of the pin and stopping short of the top, the grooves b_2 starting from the top and stopping short of the bottom. For one setting of the angle cocks *c* and *d* the right hand filter is shut off as is shown in Fig. 5, the left being in action. The fuel enters at *e* into the ring space *f* and thence into the grooves b_1. To pass into the grooves b_2 it must travel through the fit clearance *h* (see sketch adjoining Fig. 5). All impurities which fail to pass this clearance remain in the b_1 grooves. From the b_2 grooves the filtered oil passes through the ring space *s*, to the angle cock *d* and thence into the fuel valve main. To clean the filter, the box nuts *i* are removed and the filter pins withdrawn by the tap

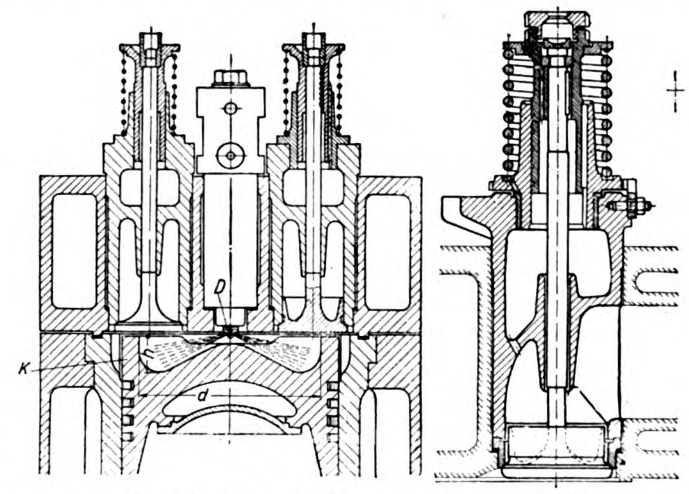


Fig. 2. Hesselman combustion chamber and fuel valve

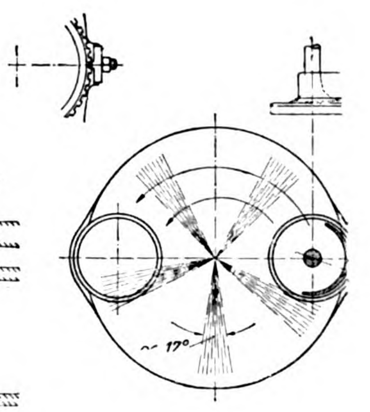


Fig. 3. Fuel nozzle

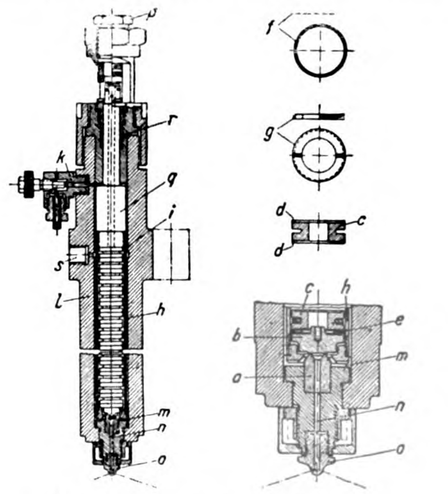


Fig. 4. Membrane fuel valve

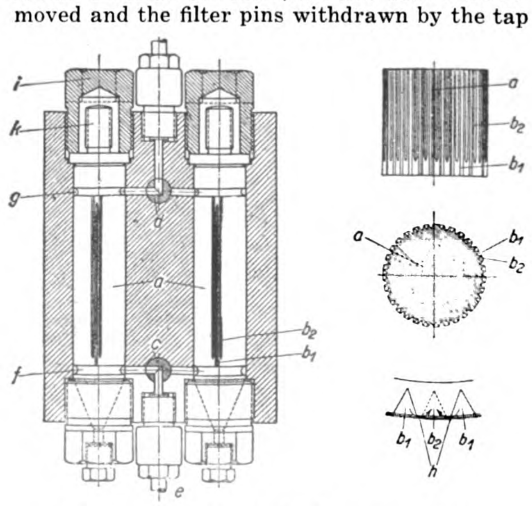


Fig. 5. Hesselman high pressure filter

* The above notes have been prepared from an article published by Dr. F. Sass in our contemporary "Werft Reederei Hafen."

† H. E. Millar and E. G. Beardsley, "Spray Penetration with a simple Fuel Injection Nozzle." Washington, 1926.

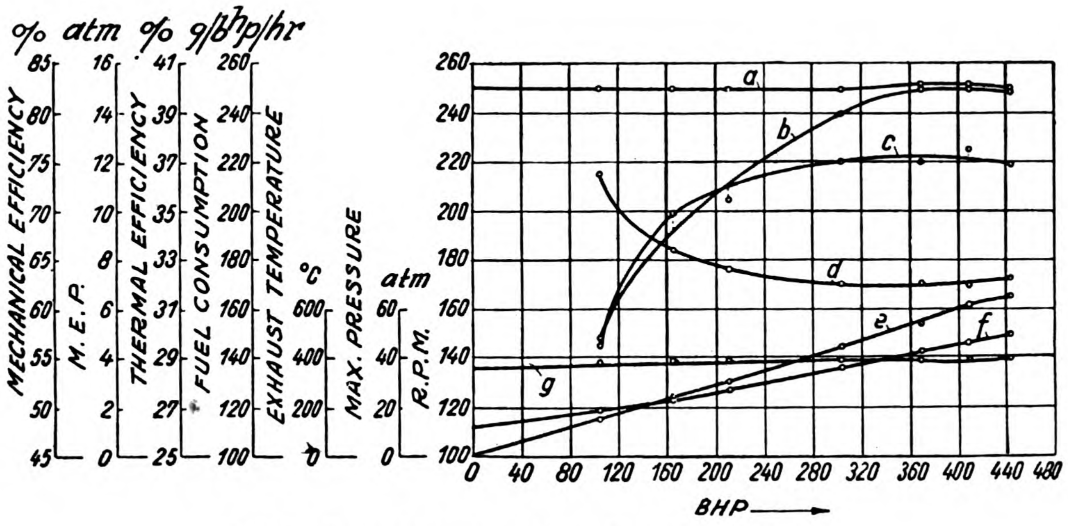


Fig. 7. Test results on a 400 hp. Hesselman Diesel

a..................r. p. m. e..........exhaust temp.
b................mech. effy. f..............m. e. p.
c..............thermal effy. g..........max. pressure
d.........specific fuel cons.

bolts k. The grooving b_1 and b_2 can be made sufficiently close that with only a play of 0.02 m.m. between filter pin and casing, an ample fuel passage is obtained, thus avoiding any throttling of the fuel. A radial play of 0.02 mm. thus results in the exclusion of all impurities greater than 1/50 mm. and protects the fuel valve from all damage due to dirt.

In designing the fuel pump for the compressorless engine not only must the high pressure be provided for but all air pockets must be avoided due to their interference with fuel timing. Fig. 6 shows the fuel pump fitted to the Hesselman engine. The pump plunger b working in the stuffing box a is driven from the fuel cam c through the roller g and roller gear c. The return stroke of plunger is actuated by the spring f. The screw h adjusts the play between roller and cam and the hand lever i is used for pumping up the pressure main prior to starting the engine. The arrangement indicated by k serves to cut out

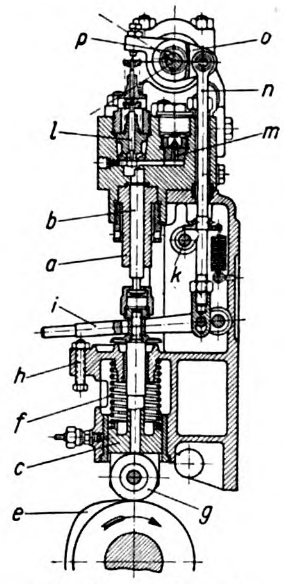


Fig. 6. Fuel pump

any single cylinder whilst the engine is running. The pump is controlled by opening the suction valve l driven by the beam o through the rod n. The pressure valve is indicated by m.

As indicative of the economical performance of the A. E. G.-Hesselman engine, Fig. 7 shows the test-bed results obtained with a 400 b.hp. set. At a mean effective pressure of 6.5 atmospheres the exhaust was quite smoke-free, the specific fuel consumption realized being 168 gram. per b.hp. per hr.

Fig. 8 illustrates a 6-cylinder 4-stroke marine oil engine embodying the features herein described. It develops 1900 b.hp. at 120 r.p.m. The principles of the design are obviously applicable to 2-stroke engines although of course much development work requires to be done before such an application can be successfully accomplished.

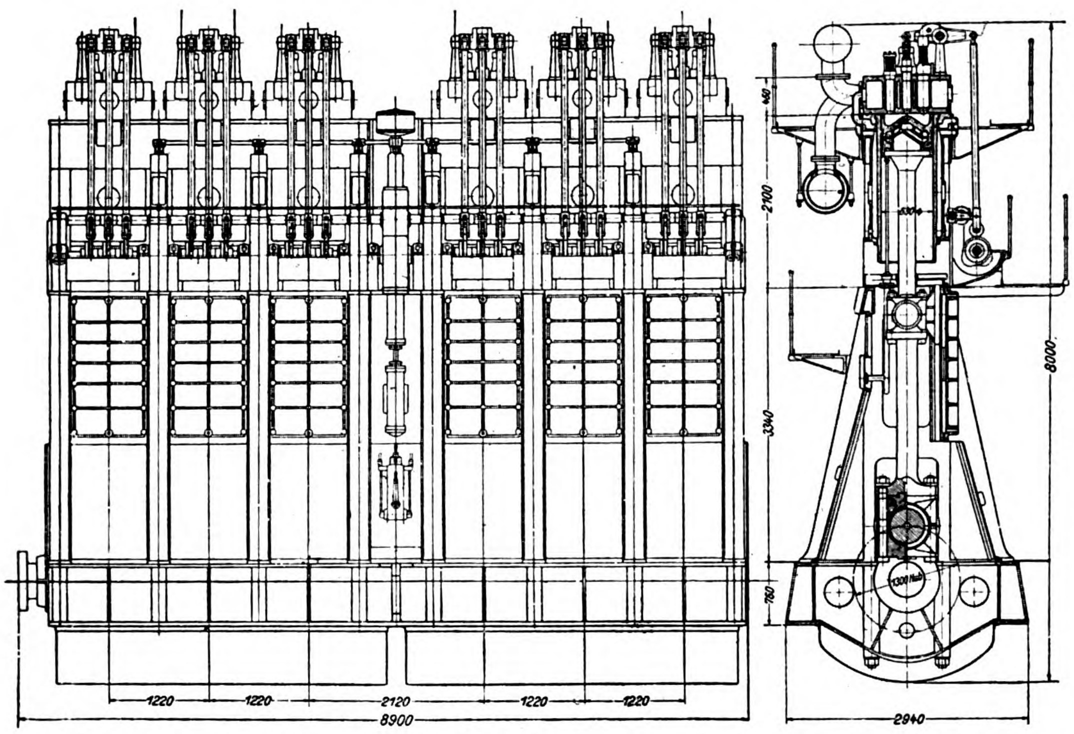


Fig. 8. A 6-cylinder 1750 b.hp. at 110 r.p.m. Hesselman marine oil engine

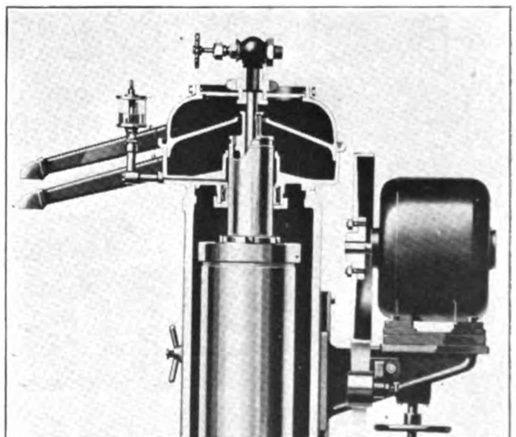
A New Centrifuge

VISITORS to the Sixth Annual Exposition of Power and Mechanical Engineering, held recently in the Grand Central Palace, New York City, showed much interest in the new type of centrifugal separator and centrifugal clarifier exhibited by the "Positive" Machinery Division of The National Acme Company, Cleveland, Ohio.

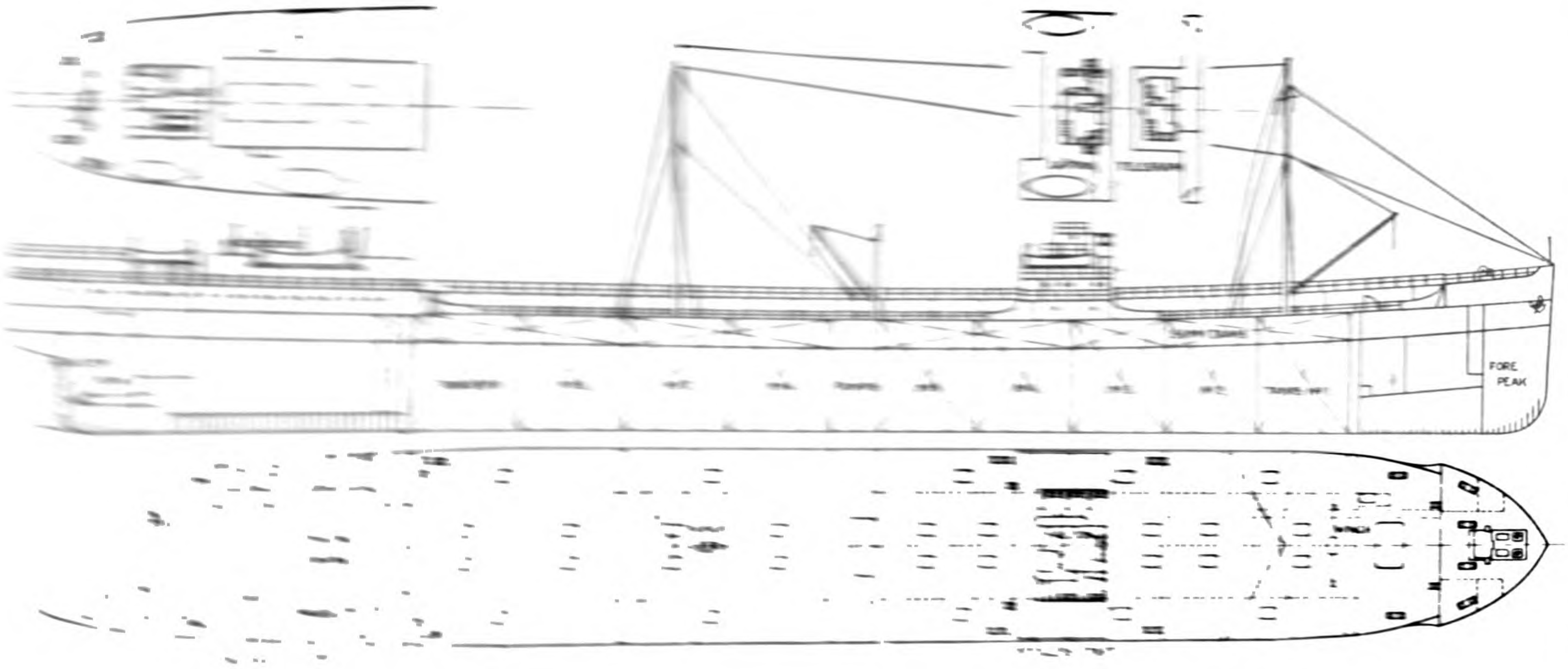
The separator not only combines two machines in one (because it can be quickly converted from a separator into a clarifier — a valuable feature when some of the products handled require clarification and separation and others clarification only), but also clarifies during the separating operation. Thus, it is claimed, when a product requires both clarification and separation, instead of using two machines, one "Positive" performs both operations.

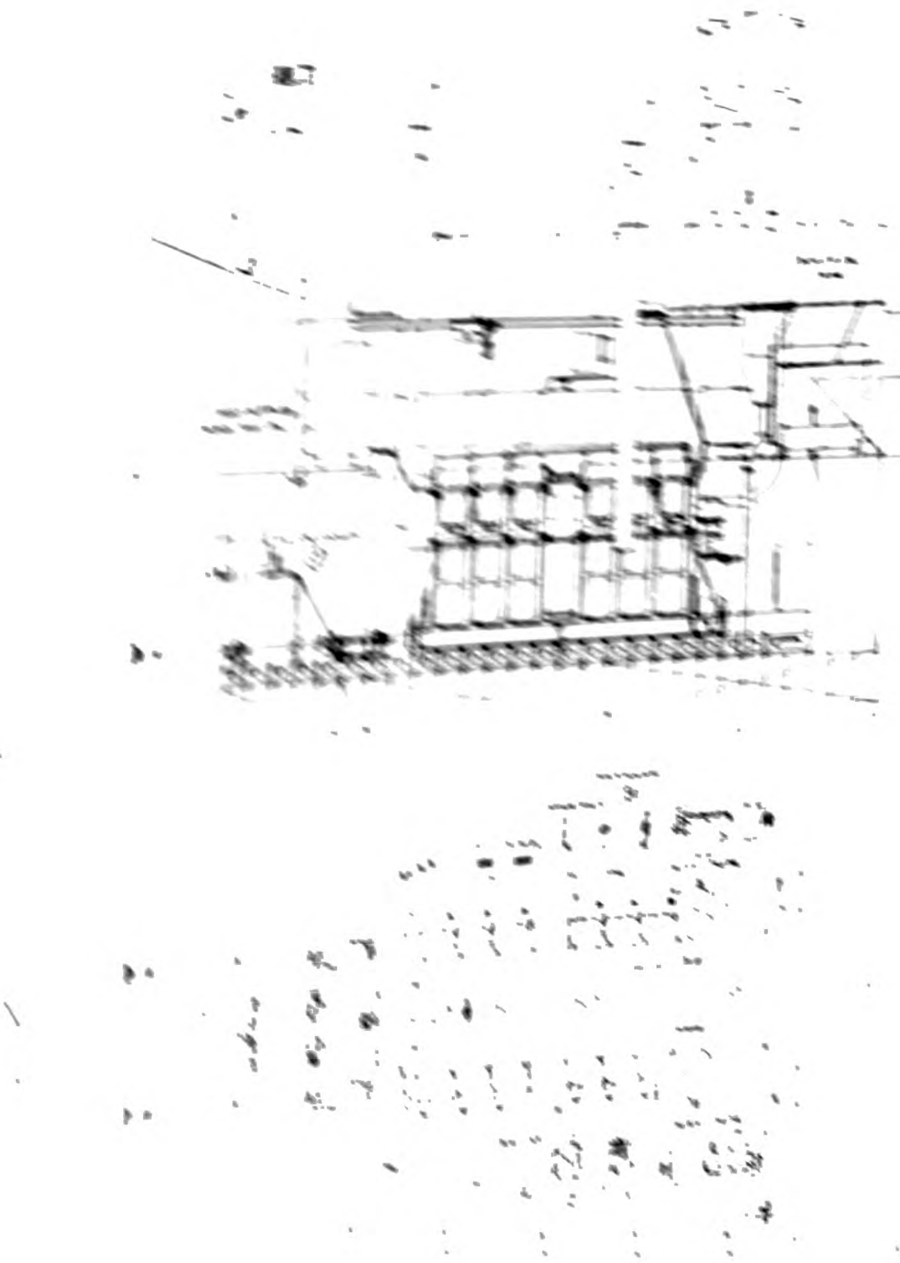
The patented bowl construction, it is claimed by the makers, enables the "Positive" to give liquids a long centrifugal travel, and also furnish large capacity for holding residue.

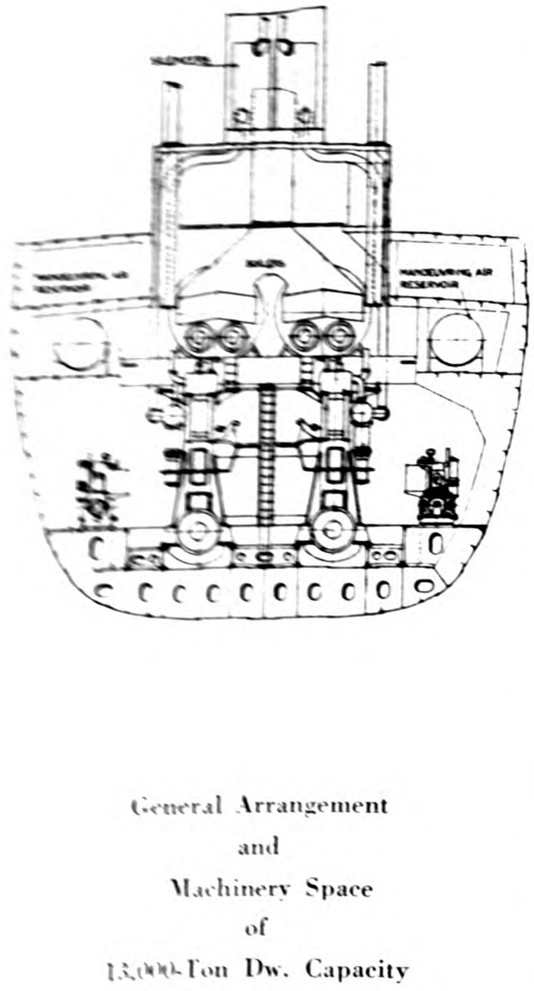
The machine is said to be of exceptionally sturdy construction. The step bearing rides on two ball bearings, and the bowl cover is supported by an over-size bronze bearing. Bowl, cylinders and pulleys are statically and dynamically balanced. We illustrate the new machine opposite.



Showing details of the Acme centrifuge







General Arrangement
and
Machinery Space
of
13,000-Ton Dw. Capacity
Motor Tanker
Christian

Motor Tanker for Standard Oil Interests

The Twin-screw Tanker Christian of 13,000 Tons Capacity Has Twin 4-Cycle Diesels of 4,289 Hp.

THE big motor tanker CHRISTIAN, one of the largest tankers built in Denmark, arrived in New York on her maiden trip last October. She has been built under special survey to Lloyds highest class on the Isherwood Bracketless system to the order of Dampskibsselskabet Myren, Copenhagen, and in accordance with the Standard Oil Company's specification. She is now employed—principally in clean oil trade between New York and Denmark—in Standard Oil Interests.

The hull is divided into 9 cargo tanks and 5 summer tanks on each side of the center line bulkhead. The cargo capacity is about 565,300 cu. ft. in the main tanks, and 65,100 cu. ft. in the summer tanks, giving a total of 630,400 cu. ft.

Forward of the oil tanks is a cargo space with a capacity of 31,000 cu. ft. bales in the lower hold, and 16,000 cu. ft. bales on the 'tween deck.

The ship can carry about 950 tons of oil fuel, viz: 500 tons in the deep tank under the forward cargo space, 250 tons in the cross bunker forward of the engine room, and 200 tons in the double bottom under the engines.

In addition two wing tanks are built on the boiler platform, holding about 40 tons of boiler oil. The fuel capacity is sufficient for a sailing radius of about 20,000 miles. The lubricating oil tanks are arranged in the double bottom right aft, and under the engines is a 100 tons fresh water tank for boiler feed water. The fore and after peaks are arranged for water ballast and carry about 315 tons.

The ship is fitted with two cargo oil pumps of Hayward Tyler make, each having a capacity of 450 tons per hour, so that facilities are at hand for discharging the oil tanks in about 14 hours.

For transferring the fuel oil from the forward deep tanks an oil pump is arranged in the pump room in the forward hold.

Three steam winches are fitted on deck, the aft one for warping purposes. The windlass is steam driven. The steering gear which is arranged in the poop, is of the electric hydraulic type.

Main deck looking aft

Well ventilated and spacious cabins are provided in the poop for the crew and engine room staff, while the deck officers and captain are accommodated amidship.

Characteristics of Ms. Christian

Length overall	488 ft. 0 in.
Length b.p.	470 ft. 0 in.
Beam molded	64 ft. 0 in.
Depth to main deck	35 ft. 0 in.
Draught loaded about	26 ft. 7 in.
Deadweight capacity (about)	13,000 tons
Gross tonnage	9,118 tons
Net tonnage	5,605 tons

The ship is fitted with two masts, and the foremast is provided with two derricks for serving the cargo hold.

The samson posts are arranged abaft the amidships deck house, each provided with one derrick for handling the pumping hoses, etc. In addition, davits are fitted along the side of the vessel for the same purpose.

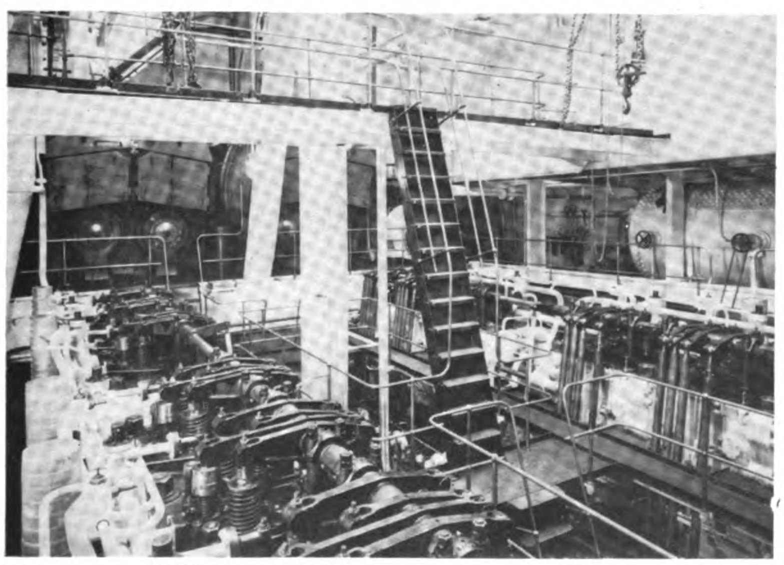
Chain lockers, lamp and paint stores, as well as the carpenter's workshop are situated in the forecastle. Each oil tank is provided with one hatch, and the cargo hold forward is fitted with an oil tight hatch in the main deck.

The propelling machinery consists of two sets of 6-cylinder, cross-head type, single-acting B. & W. Diesels, capable of developing 3,800 i.hp. at 130 r.p.m., giving the ship a sea speed of 11¼ knots at loaded draught.

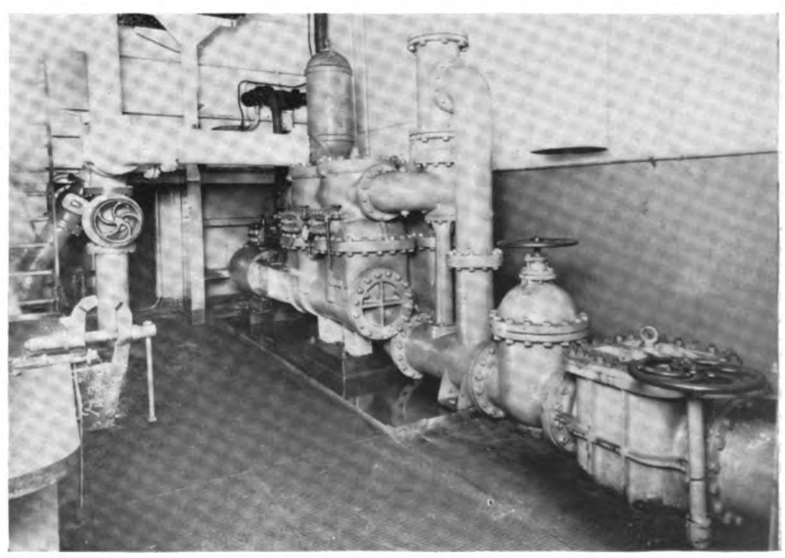
The auxiliary machinery is partly electrically and partly steam driven. One generating unit is arranged in each wing of the engine room, each comprising a two-cylinder 100 b.hp., B. & W. engine, running at 400 r.p.m. and driving a 66 kw. dynamo. Steam is supplied from two oil-fired cylindrical boilers, arranged on a platform deck at the forward end of the engine room. The boilers are 11 ft. 2 in. diameter by 10 ft. 4 in. in length, each having a heating surface of 1,300 sq. ft., and designed for a working pressure of 180 lb. per sq. in.

The pumping facilities consist of two "Heavy oil" cargo pumps, each of 450 tons capacity per hour, arranged in the pumping space amidships. In addition, one steam-driven horizontal duplex pump of 50 tons per hour capacity is fitted in the same room arranged for a working pressure of 180 lb. per sq. in. with a piston speed of 90 ft. per min., and connected to the "Stripping line" system for draining the main as well as the summer tanks.

MS. CHRISTIAN ran her acceptance trials in the Sound at Copenhagen. A speed trial over the measured mile was held, giving the ship a speed of 11.38 knots, the engines developing 4,289 i.hp. at 129.3 r.p.m. The draught of the ship was 26 ft. 4½ in. mean.



Cylinder tops of two main 4-cycle Diesels



Cargo pumps in pump room

Motorshipping Visualized as a New Era

Displays of Motorship Models and Maps of World Wide Services Rendered by Motorships Made by General Steamship Co.

THE Pacific Foreign Trade and Travel Exposition held in San Francisco recently featured principal commodities and manufactures entering into world trade. Manufacturers and producers, interested in expanding their markets across the Pacific and in developing the Western market as well, participated in this event. The displays of transportation lines were particularly impressive. The world wide service rendered by the many motorship lines operated by the General Steamship Corporation was visualized in a most attractive manner by a special display occupying a large space in the central section of the auditorium and including a model of the motorship SILVERAY built to exact scale, and 11 ft. in length. SILVERAY is one of a fleet of six motorships operated in the Pacific, Java, Calcutta service of the Kerr Lines. They proceed from Los Angeles and San Francisco to the Dutch East Indies, and Straits Settlement and Calcutta, thereafter returning to the Pacific Coast via the same route. They furnish the fastest service from the United States to that territory, and carry large consignments of automobiles, canned goods, petroleum products, lumber, etc. Homeward, cargoes comprise rubber, kapoc, gunnies, coffee, copra, and other Oriental products. Sailings from Los Angeles and San Francisco are maintained upon a monthly basis.

Kerr Lines have recently announced the inauguration of a similar service with two American motorships from Seattle and San Francisco to Singapore, Madras and Calcutta, with return via Honolulu, thus extending the Silver Line activities to the Northwest. A large painting 20 feet in length extended across one side of the exhibit over the model of the SILVERAY, which depicted the various countries of the Orient visited by the motorships in the service just described, was effective. At the left of the motorship model was a large card giving the names of the motorships and a list of the countries visited by the Kerr Lines.

The section of the General Steamship Corporation's display devoted to the Libera Line of five fast motorships giving freight and passenger service between the Pacific Coast and Mediterranean Ports, comprised a 20 ft. painting depicting the interesting things seen in the countries visited by the motorships on this line. This display also contained a large painting on which were visualized the various imports carried from the ports visited. There was also a large display of folders devoted to a description of the interesting places visited by these motorships, which was designed to interest visitors in the excellent passenger accommodations of these motorships, which are modern and commodious. Smoke room, ladies' parlor and dining saloon are spacious, with furnishings in the best taste. Radio, piano and phonograph enliven the hours with music; and there are adequate facilities for letter-writing, reading, playing bridge undisturbed. Passengers enjoy informal dances in the social hall or on deck.

Broad sheltered decks are reserved for the passengers. Deck chairs are furnished free of charge. The outdoor swimming tank on each motorship, with running water while in the tropics, invites travel on the Libera Liners.

A section of the exhibit was devoted to displays featuring the South America Westfal-Larsen Line and the North Pacific-Australia Direct Line and California-Australia Direct Line. Four motorships are used in the Pacific-Australia Direct Line Service. As there are no stops enroute, these rapid vessels carry passengers and cargo direct to Brisbane, Sydney, Newcastle, Melbourne and Adelaide in record time. They load lumber, petroleum products, canned foods and manufactured goods, and have grown to be a vital link in American trade with the Australian Commonwealth.

A feature of this section of the display was a large map showing the countries visited by these three lines and the routes marked on the ocean. The principal industries of the various countries are visualized by drawings; for instance, a sheep and a kangaroo being represented on the space occupied by Australia. A large painting 20 ft. in length depicted the most interesting scenes to be found in the countries visited by these Lines.

Ms. BRANDANGER, one of the vessels operated in the South American Westfal-Larsen Line holds all speed records in this trade. Sailings are maintained on a monthly basis. Southbound shipments are comprised of lumber, canned goods, dried fruit and manufactured goods from the Pacific Coast, while on the homeward voyage, the vessels bring coffee from Brazil and packing house products and other materials from Argentine. The route of the vessels from the north Pacific Coast ports is direct to the Straits of Magellan. Passing through these scenic Straits, the vessels circle South America, cruise the Patagonian Coast and then run up to Bahia Blanca, Argentine.

From Bahia Blanca the route extends to the Buenos Aires. The next port of call is Montevideo. Santos is the greatest coffee port in the world. The trip from San Francisco to Buenos Aires gives the traveler about 30 days at sea, offering a complete isolation from the world on board a large freighter with excellent passenger accommodations.

A further section of the exhibit was devoted to the French Line, for which service three new motorships will soon be constructed.

Why the Motorship Is a Conserver of Fuel and a Power of Shipowner's Money

(*Continued from page* 21)

tremely difficult to obtain. Here one records an increase of from 16 gal. for 11.5 knots and 3,400 s.hp. to 37 gal. with 14 knots and 7,000 s.hp.

The point to be made very definitely is that fuel and lubricating oil consumption increase slowly, with increase of power and speed, for the motorship. For the steamer they increase at a much greater rate, as the curves show.

Table C is in effect a variation of Table B, with again the "size" of the ship as constant. These data are all for twin screw ships—another constant. An increase of speed from 11½ knots to 14 knots means a s.hp. increase of 3,600 s.hp. or 1,800 hp. per engine—just 4 cylinders extra per engine in the cases we have taken. The 8,000 hp. engines drop to 6 cylinders per engine, but this is because they are double acting cylinders. Twin engines of the 4-cycle double-acting type used singly on a big fleet of 11-knot tankers are able to develop 7,000 hp. total in 6 cylinders per unit (32.2 in. cylinder diameter by 59 in. stroke).

Table D has no constants but is merely a record of power and speed, with size of ship. The highest powers, perhaps naturally, are arranged on a 4 shaft layout. The r.p.m. show no great fluctuations for a speed range of about 4 knots and a power range of nearly 9,000 hp., the average being in the neighborhood of 103.45, which can certainly not be advanced as a criticism against Diesel propulsion for high powers. The big engines concerned are turning at quite moderate speeds—particularly those for the 100,000 hp. layout. This is just as well because these big engines each have 12 cranks per shaft with a throw of nearly 6 ft. The scheme is an important one.

A few years ago a 42,000 s.hp. motorship was regarded askance when suggested at a *meeting of the Institute of Marine Engineers, London. Today we have 100,000 hp. on four shafts not only proposed but almost ready for construction for a 60,000 ton transatlantic motor liner. Such a ship, one may compute, will consume about 1,100 tons of oil per day for all purposes. The corresponding motorship will use, at the most, 350 tons per day. Each ship will necessarily carry fuel for about 12 days. The motorship must have tankage for 4,200 tons of oil, the steamer would have tankage for 13,200 tons. The motorship has some 9,000 tons to the good or can be a proportion of this amount smaller according to the type and arrangement of machinery. The coal burner, and particularly the pulverized coal burner with its necessary huge pulverizing plant, is absolutely out of the question.

* See "Motor Passenger Liners," Trans. & Mar. E., August 25.

Airless-Injection Double-Acting Engine

A 2-Cycle Port-Scavenging Design with Neither Compressor nor Camshaft Introduced by Richardsons, Westgarth

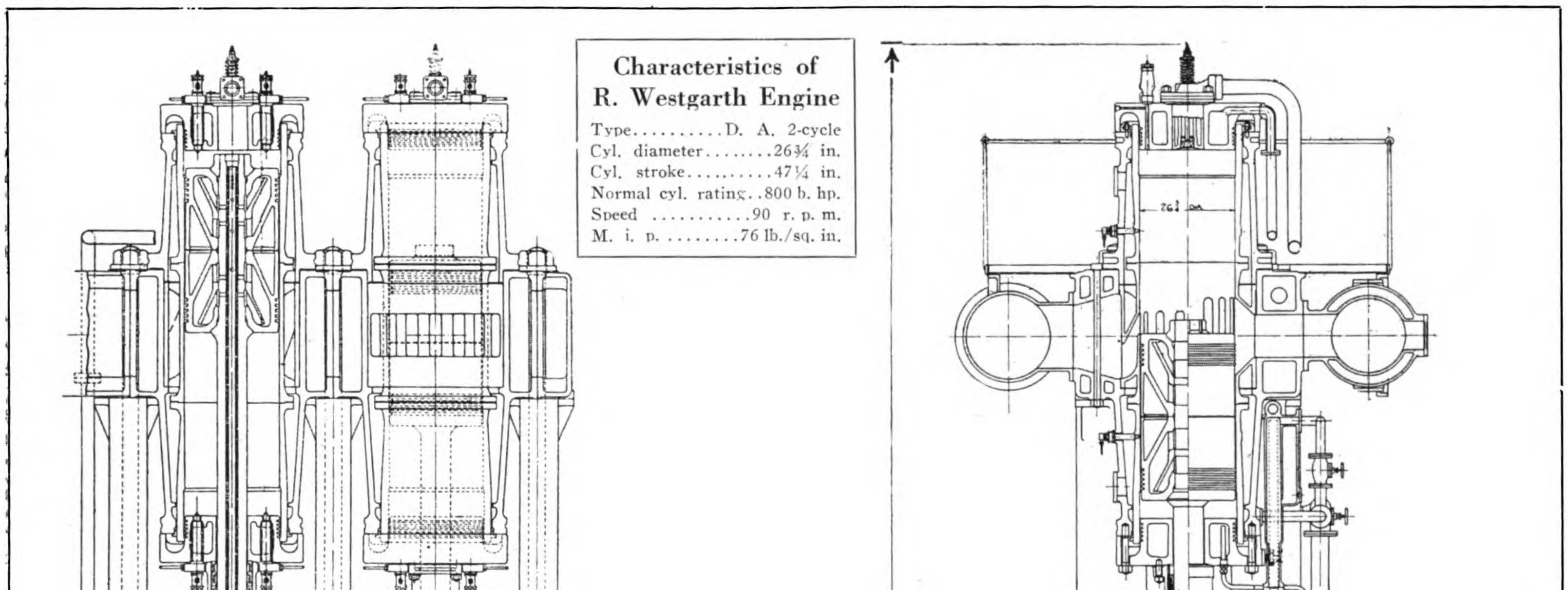
WORKING on the 2-cycle principle with port scavenging and airless injection of fuel, a new double-acting Diesel engine has been developed by Richardsons, Westgarth & Co., Ltd., a British marine engineering firm located at Hartlepool on the Northeast coast. A single cylinder unit of this engine with cylinder diameter 26¾ in. by 47¼ in. stroke, developing 800 b.hp. at 90 r.p.m. has been on the test bed and is ready for production.

The makers plan to build their engine in multi-cylinder units ranging from three to nine cylinders. The three- and four-cylinder units are to be built operating normally at 90 r.p.m. and developing 800 b.hp. per cylinder. From and including the five-cylinder unit up to the nine-cylinder unit, the engine will operate either at 800 b.hp. per cylinder at 90 r.p.m. or at 1100 b.hp. per cylinder at 125 r.p.m. The weight of the engine per b.hp. including the flywheel, thrust block, and after bedplate is 172 lb. for the three-cylinder 2400 b.hp. unit. For the six-cylinder 6650 s.hp. unit (at 125 r.p.m.) the weight per b.hp. is 115 lb.

The upper and lower cylinder ends are of identical construction. The liner is held at the center, at the scavenge and exhaust belt, by the upper cylinder jacket in such a manner that all grooves and rubber rings are dispensed with and both ends left free to expand. The scavenge and exhaust belt is a separate casting bolted to the end liners which are made of a specially tough mixture. Complication is therefore confined to a comparatively small casting subjected to low heat and mechanical stresses.

The cylinder liner has patent alternate scavenge ports which enable ample port area to be obtained with a minimum length of liner. The nozzle ports permit scavenging to be accomplished independently of the shape of the piston ends and are separate for top and bottom cylinders. When the scavenge port is only partly open, the side of the piston forms part of the scavenge nozzle and directs the air almost vertically upward, the line of flow falling as the port is opened.

The length of the exhaust ports is such that the upper portion exposed to gases from the upper cylinder is never exposed to the gases

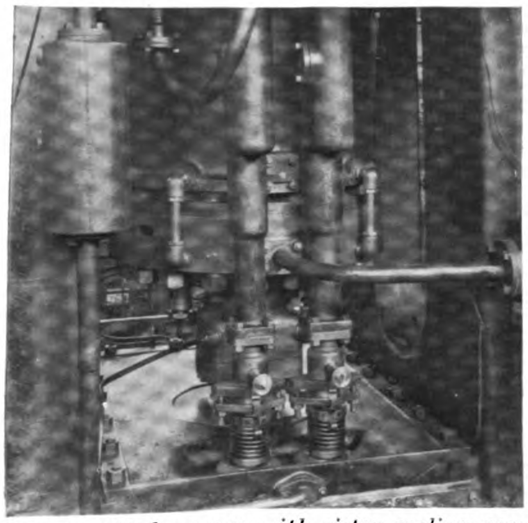


Characteristics of R. Westgarth Engine

Type	D. A. 2-cycle
Cyl. diameter	26¾ in.
Cyl. stroke	47¼ in.
Normal cyl. rating	800 b. hp.
Speed	90 r. p. m.
M. i. p.	76 lb./sq. in.

The Richardsons, Westgarth double-acting, 2-cycle, airless injection Diesel weighs 175 lb. per hp. for a 4-cylinder unit complete

from the lower cylinder and vice versa. The exhaust port bars are water-cooled and of large cross section. All the cylinder cooling water passes through the bars and thus these are kept at a low temperature corresponding to that at the scavenge side which is only partially water-cooled. This makes for an equal temperature throughout the belt. Lubri-

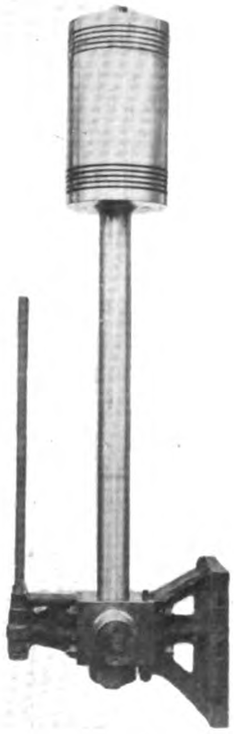


Bottom cylinder cover with piston cooling gear

cation of the piston and liner is effected through five feed holes at about the mid-height of both top and bottom cylinders.

The cylinder cover joint consists of a special spring ring joint construction fitting axially between the cover and the top of the liner. Top and bottom covers are identical in all respects, being of ribless construction with one central hole to accommodate the starting air valve in the top cover and the piston rod in the lower cover. The two fuel valve pockets are formed by copper tubes expanded into holes in the cover, and a hole is also provided for the relief and indicator connections.

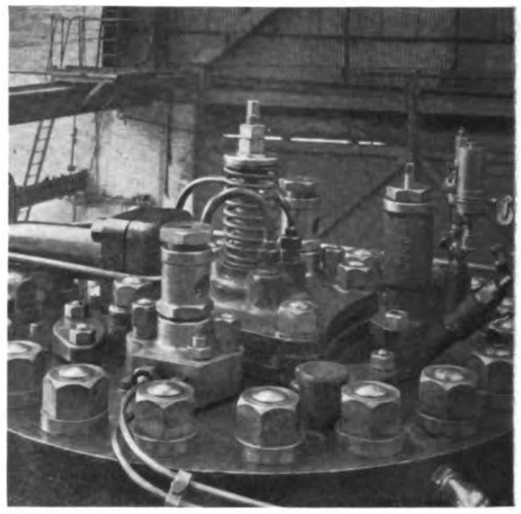
Fresh water cooling is used for both cylinders and pistons. Circumferential ribs in the cylinder jacket and multi-connections to the cylinder heads secure even distribution of the cooling water about the liner and even cooling of the heated parts. Cooling water is con-



Piston, piston rod, crosshead and cylinder cooling tube

veyed to and from the piston and piston rod via the cross-head by means of two trombone pipes, the plunger tubes of which are attached by a bracket to the cross-head. The outer water chamber is external to the crankcase and at the uppermost point is mounted in bearings attached to the cylinder casing to give flexibility to the system and allow for any slight movement of the cross-head or misalignment of the trombone pipes. Double glands are provided which are external to this crankcase to prevent oil leakage to the cooling water or water leakage into the crankcase.

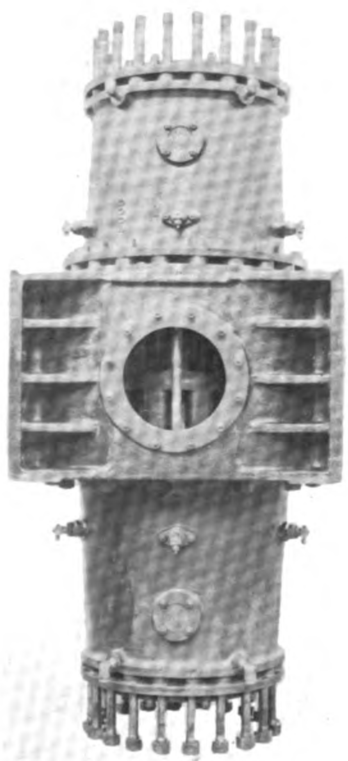
The pistons consist virtually of two single-acting pistons of identical construction. Special water joints and connections are eliminated as far as possible and special cast nozzles are adopted to distribute the cooling water efficiently about the piston. Both pistons may be removed without disturbing the rod. The piston top is machined flat and the



Top cylinder cover

pistons generally are of ribless construction. The trunk is cast on the the body with provision to expand axially. The pistons are secured t the rod between a shoulder on the rod and a special nut of non-corrodable material, the recesses in both piston ends being identical. The piston rod is of three per cent nickel steel with a tensile strength of 50 tons per sq. in.

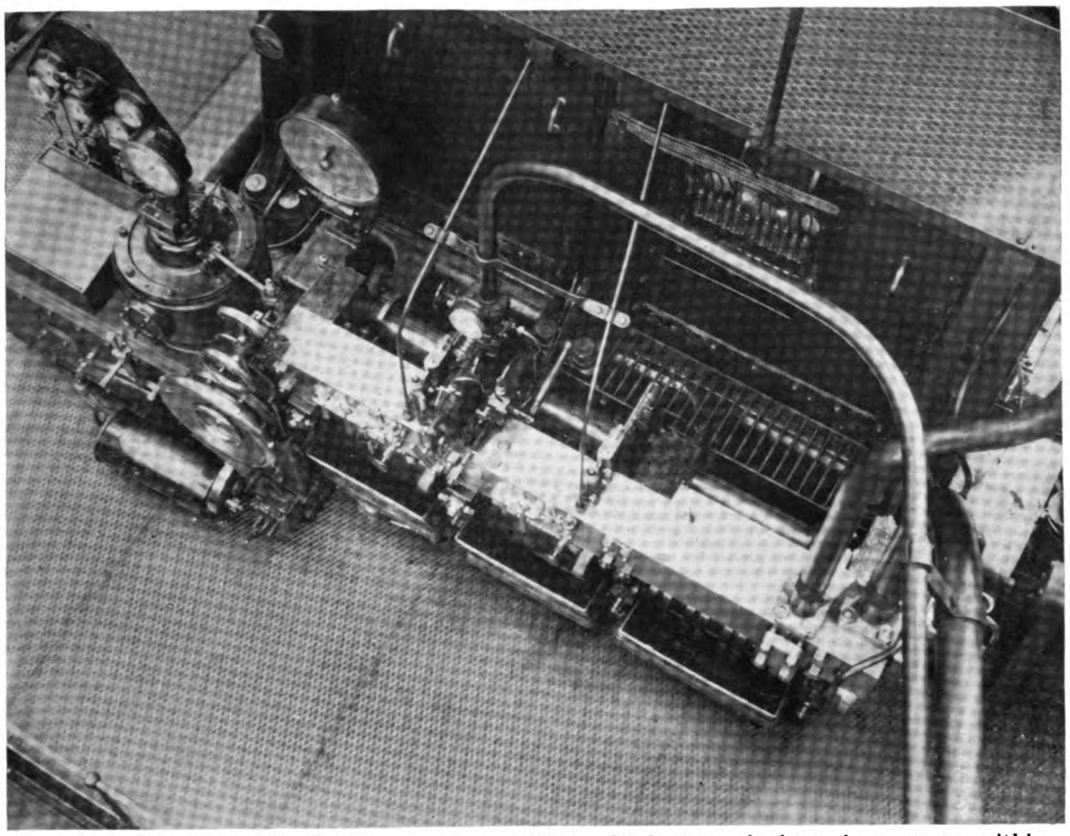
The main feature of the piston gland is a long annular water-cooled passage extending the full depth of the cover which the hot gases must traverse before reaching the packing rings. The packing itself comprises a number of solid rings, a good fit on the rod to damp down the peak pressure, then three ring cases each containing two sets of cast iron sectional rings with circumferential garter springs. The sectional rings are in three pieces separated by three wedges and held tightly together by steel garter springs. Lubrication is effected by in-



Details of outer cylinder cover

Bottom of lower cylinder cover and piston rod gland

Cylinder liner and scavenge and exhaust ports



Main control position, fuel pumps, cams are all on the bottom platform in a group within easy reach

troducing oil through a number of holes in the second sectional-ring case fed by two separate lubricating oil pipes.

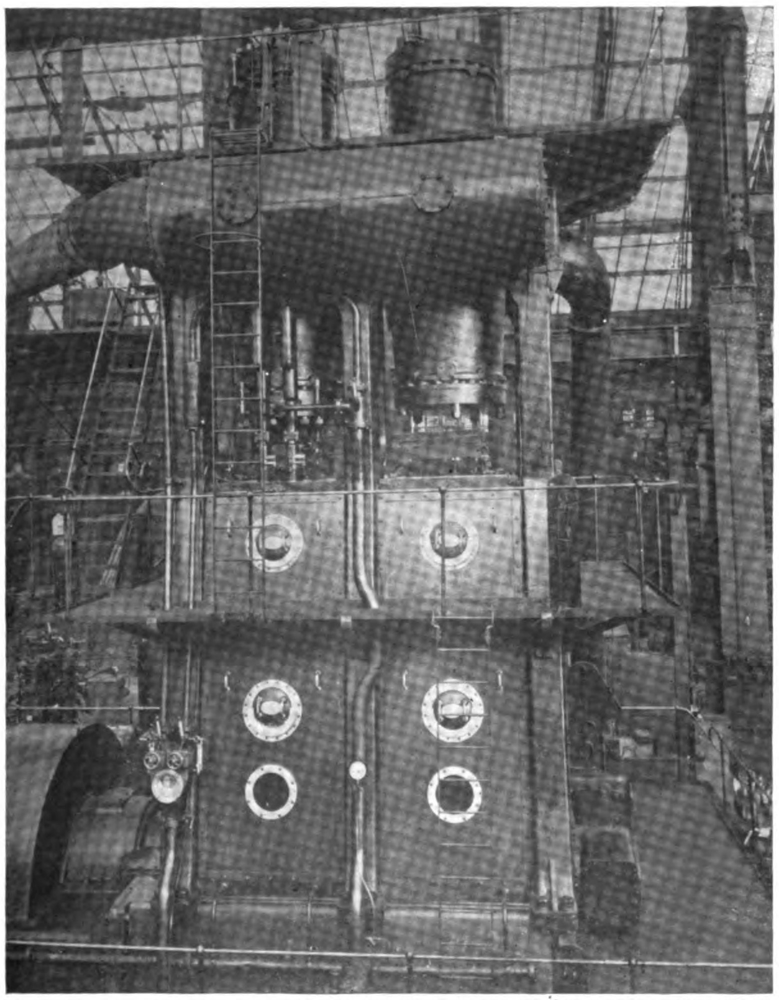
Airless-injection is employed with spring loaded automatic fuel valves, and there are two identical automatic fuel valves for both top and bottom cylinders. The top and bottom combustion spaces are made almost identical, each consisting of a simple annular space with flat ends, the volume being such as to give a compression pressure of about 350 lb. per sq. in. The piston rod nut in the top cylinder approximately corresponds with the piston rod in the bottom cylinder.

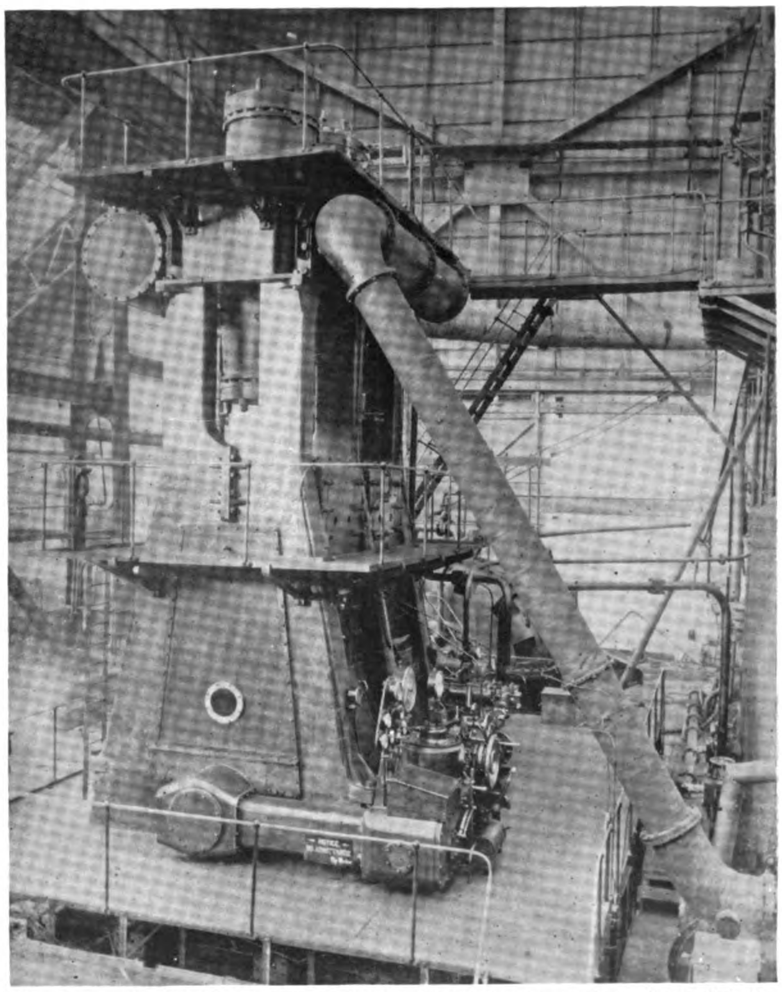
The airless system of fuel injection requires no direct fuel valve operating gear and thus permits the starting air valves in the cylinder heads to be of automatic type with master valves arranged near the fuel pump and driven from an extension of the fuel pump camshaft. It is therefore possible to eliminate the usual cam and maneuvering shafts, etc., and to replace these by a unit in front of the engine at floor level comprising fuel pump governor, starting air operating valves and control gear, the whole unit being driven from the forward end of the crankshaft.

The fuel valves are fitted with adjustable spring loaded needle valves working in glandless cast iron bodies. Injection pressure of the fuel oil can be readily adjusted by adjustment of the spring load on the needle, and timing and rate of injections are controlled by the pumps, the plungers of which are cam operated. A separate and independent pump and gear are provided for each cylinder end, each plunger operating two fuel valves. The pump plungers are cam operated through rockers, the return stroke being made by a spring. The rockers are mounted on an eccentric shaft capable of angular movement. The suction valves are mechanically operated by means of tappets on bell cranks connected with the plunger rockers by links and mounted on an eccentric control shaft. Fuel injection control is obtained by angular movement of the eccentric rocker shaft, a control cam on which operates the eccentric suction valve control shaft and lowers or raises the tappet bell crank according to the load. This regulates the period the suction valve is closed and so the useful stroke of the pump, the suction valve being closed during the pressure stroke a greater or less amount depending upon the position of the eccentric control shaft.

Starting air valves are fitted to the top covers only, being arranged in the corresponding pocket to that used for the piston rod in the lower cylinder. Starting air master valves consist of balanced poppet valves working in

(*Continued on page* 54)





The Richardson, Westgarth airless-injection, double-acting, 2-cycle Diesel develops about 800 hp. per cylinder at 90 r.p.m., using about 0.4 lb. of fuel per b.hp. hr.

Big Steam Deck Lighter Converted

A 500 Hp. Diesel Being Fitted in a New York Harbor Lighter Will Give Active Demonstration of Economy

MEN interested in New York Harbor shipping are today witnessing the steady growth and adoption of the Diesel engine in all classes of harbor craft. There are, at present, a large number of Diesel tugs and ferries, as these vessels utilize their power on either 12 or 24 hour basis and the resultant economies of the Diesel engine permit paying off the initial investment within two to four years. Lighterage concerns have as yet hardly begun to appreciate the economy to be effected with the Diesel engine, and accordingly adhere to obsolete steam practice.

The average deck lighter, if used for example on a 12 hour basis, spends possibly 4 to 5 hours in running, and the balance of the time loading or discharging cargo. These long lay periods are interrupted with shifting the vessel from pier to pier, to facilitate handling the freight. It is, consequently necessary to maintain sufficient steam pressure at all times, resulting in considerable coal consumption. The Diesel engine is particularly adapted to lighterage service, as no fuel is consumed at the dock, although the engine is ready for immediate operation for maneuvering the vessel.

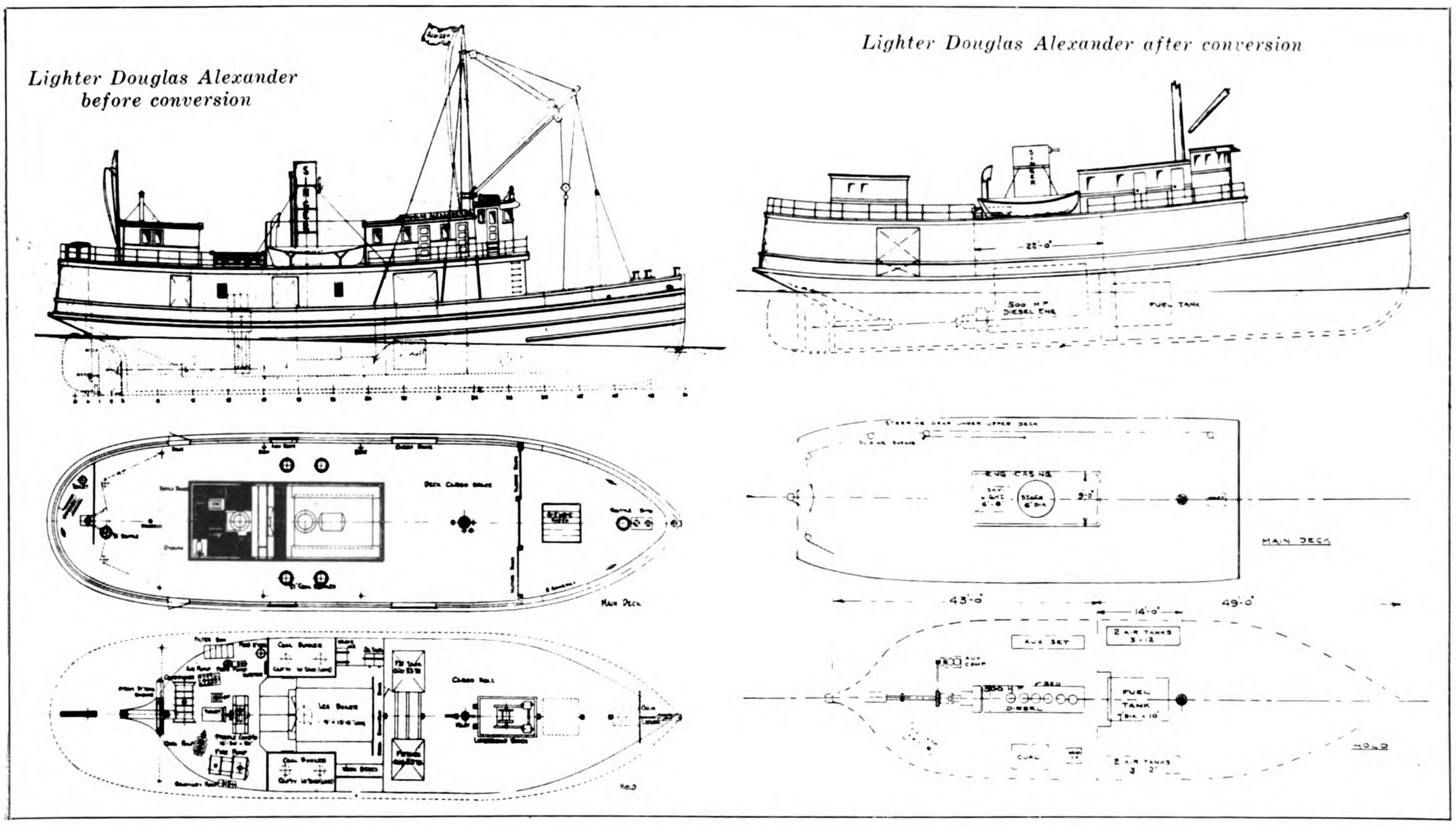
An interesting lighter conversion, from steam to Diesel power, is the DOUGLAS ALEXANDER, owned and operated by the Singer Manufacturing Company of Elizabethport, New Jersey. Her dimensions are: Length 107 ft. 6 in., breadth 28 ft. 6 in., depth 10 ft. 6 in.

500 hp. Nelseco Diesel

A Nelseco Diesel engine of 500 hp. built by the New London Ship & Engine Co., Groton, Conn., is being installed and it is expected that a speed of 12 to 13 miles an hour will be obtained. The engine is of the 6 cylinder, airless injection, 4 cycle direct reversible type. Operating controls will be so arranged that maneuvering may be carried out from either the main deck level or the engine room floor.

The picture gives a general view of the engine, although it does not illustrate the new control arrangement. The attached drawings illustrate the DOUGLAS ALEXANDER, as originally equipped with steam and the new arrangement with the Nelseco engine installed. This comparison shows the small engine casing on the main deck, which directly increases the freight carrying capacity and also the simplified auxiliaries below deck. The increase in deck space is highly desirable as the Singer Manufacturing Co. uses the boat for delivering large shipments of sewing machines to the steamship lines around New York Harbor.

Eads Johnson is in charge of the conversion work, which is being carried out at the W. & A. Fletcher plant in Hoboken. Prompt deliveries are being made on the machinery and installation work, and the DOUGLAS ALEXANDER goes on service as a Diesel lighter early this month.



Hudson River Motorships

The Hudson River Night Line, according to latest advices as we go to press, is actively working on plans and details for the two new Diesel vessels which it has decided to use between New York, Albany and Troy.

Great Lakes Dredge Co., Chicago has ordered a tug powered by a 1000 hp. Busch-Sulzer Diesel.

Shipping Board Auxiliary Diesels

Bids are being opened on January 4 by Capt. R. D. Gatewood of the U. S. Shipping Board for the supply of four small and 12 large auxiliary Diesels for four of the new Diesel conversions. These bids include, presumably, 3 big engines and one standby engine (for generator and generator compressor work) per ship. The engines must be of approved type, suitable for marine use, for driving 240-volt d.c. generators. The generator bases are to be arranged in such a manner that the generators will be forward in the vessel when installed on port and starboard side and the valve gear and ladders on the inboard side or as may be directed to suit installation. They must be of the vertical 2 or 4-cycle type, have not less than three cylinders, short or medium stroke, medium speed, heavy duty, crosshead or trunk piston, non-reversible type.

Science as an Aid to Ship Navigation

Echo Sounding, with Its Many Advantages, May Now Be Considered Superior to Sounding Machines for Some Duties

By W. E. Parker*

Echo Sounding

Believing that the development of Diesel propulsion for shipping is synonymous with all-around improvement in ship operation technique, MOTORSHIP has always sought to keep in touch with the latest improvements in navigational devices. In consequence, we communicated some time ago with Col. E. Lester Jones, Director U. S. Coast and Geodetic Survey, for his opinion—as an authority—on echo sounding for navigation. His reply was that at the time his department was investigating various types of echo sounding apparatus, and that while they were getting promising results, they did not feel that they were sure enough of any apparatus, suitable for installation on merchant ships, to make any statement for publication. However, he did promise to give an article on this subject at some later date if developments justified an endorsement of echo sounding for use in the merchant marine. Col. Jones believes the time has now come when he can safely recommend such apparatus for use in the merchant marine and Commander W. E. Parker, Coast and Geodetic Survey, has accordingly prepared this article for us.

THE science of navigation has advanced not so much by gradual development and improvement of methods and appliances as by the discovery of new methods and the invention of new appliances. It has developed largely by jumps and bounds rather than by steps. With each jump, vastly greater possibilities have opened up for the safe and certain passage of ships.

The first of these great steps was the invention of the astrolabe and the discovery of so much of nautical astronomy as enabled the ancient mariners to determine, however crudely, their latitude. The mariner's compass followed, if indeed it was not known in some form in the Orient at an even earlier date.

With these two instruments the ancient sailorman was compelled to find his way as best he could. The wonder is that he did so well—latitude by crude observations and longitude by course and estimated distance. Centuries later the marine time piece, the chronometer, was invented and was hailed the world over as the means by which navigation was at last placed upon a firm foundation. Meanwhile the astrolabe and its brother the cross-staff had given place to the sextant family—the octant, quadrant and sextant—and it was then possible to "shoot" the sun and stars with some precision.

The mariner was then able to conduct his ship exactly where he chose provided always that he encountered a clear sky or could occasionally get a glimpse of a heavenly body. However, that was not always his lot and even today much "dead reckoning" enters into navigation.

While appliances and methods enable a ship master to lay out a true course from departure to destination and to hold that course reasonably well, unless he encounters much cloudy weather, yet if he departs ever so little from that course he misses his landfall and perhaps gets into dangerous waters. He must then feel his way by sounding.

The Kelvin sounding machine, devised by Lord Kelvin some 50 years ago, was one of the great aids to navigation because it permitted the mariner to feel his way, after having arrived on soundings, without stopping his ship. But by that time the speed of ships had increased to a point where it was not possible to get the bottom without slowing down. Consequently the sounding machine is not used as frequently as it should be and as a result there are many strandings that might have been avoided had the master been willing to slow down and take soundings.

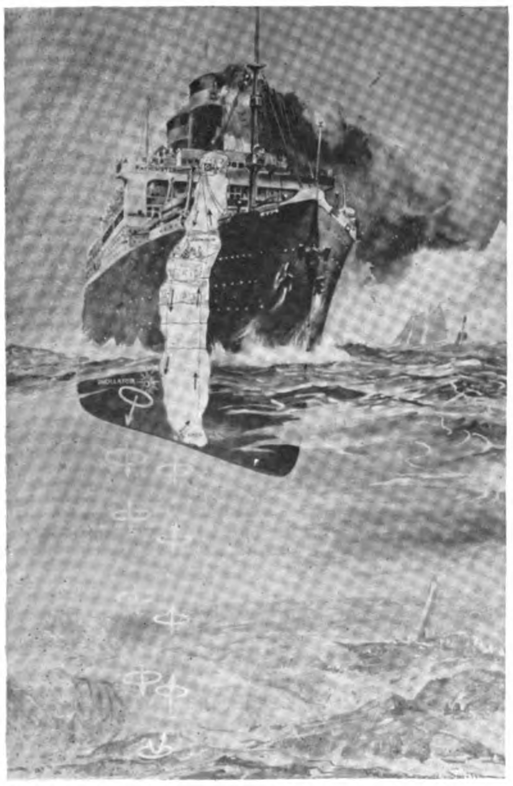
This condition is now remedied by the invention of the echo sounding machine. With this apparatus, it is now possible to measure the depth, traveling at any speed and furthermore in any depth likely to interest the ship master. The apparatus is comparatively new but has clearly passed the experimental stage. It is a practical navigating machine of great value to the safety of navigation and should meet with the hearty approval of mariners because of the assistance it can render them in finding port and the sense of security that must result from positive information as to the depth at any time and the rate at which the depth is changing.

These machines are so new that as yet few vessels other than surveying ships and war vessels are equipped with them but as they become better known, demand for them will grow. It is not improbable that within the near future all well equipped ocean going motorships will carry them.

The echo sounding machine is the result of experiments in sub-aqueous communication between ships and the discovery that a sound wave striking the sea bottom gives back an echo just as does a sound in the air on striking a wall. The first experiments in sounding by echo were performed shortly before the World War but were not followed up then because the very great demand for research in submarine detection took precedence over all other sub-aqueous investigations until means had been devised for combatting the submarine. Immediately on the termination of the war, scientists again took up the subject of echo sounding. In Great Britain, France, Germany and Italy as well as in the United States researches were carried on in this subject and in all of these countries some form of echo sounding apparatus was devised.

In the United States the Submarine Signal Corporation perfected an apparatus

* Commander U. S. Coast & Geodetic Survey; Chief, Division of Hydrography and Topography.



Sketch showing operation of Echo Sounder

Fathometer, or depth indicator, in chart room

of this kind and has recently placed it on the market. This apparatus while intended primarily for use in depths of 100 fathoms or less, has been found to give excellent results in depths as great as 2500 fathoms. It is probable that with a more powerful sound producing mechanism the greatest depths of any ocean can be measured with this apparatus.

Echo Sounders

All of these sounding machines, the American as well as the European types, have these essential parts which, while different in design and method of operation, accomplish the same ends; a means for producing a sound under water, a means for detecting the echo from that sound, and a means for measuring the time interval between the emission of the sound and the reception of the echo.

In most types of echo sounding apparatus the sound is produced by the vibration of a steel plate under the influence of a powerful electro-magnet. This apparatus, called an electric oscillator, is bolted to the outside of the ship's plating near the keel or let into the plating. The echo is received by a hydrophone, one type of which resembles in principle the ordinary telephone transmitter, but there is a type of hydrophone that is similar to the oscillator, described above except that the process is reversed—the echo causes the plate to vibrate, thereby producing fluctuations in the electric current flowing through the hydrophone. The timing apparatus is a mechanism driven by an electric motor, its speed controlled by a suitable governor, and on which is recorded in various ways the instant of sound production and the instant of echo receipt. The time interval between those two instants is indicated by the distance a moving part of the machine has travelled during that time interval.

Since the velocity of sound through water is about 4800 ft. per sec., it is necessary that the timing device be such that the time interval can be measured to less than one one-hundredth of a second in order to accurately measure the depth to the nearest fathom. Some machines measure the time interval so precisely that the depth can be determined within one fathom or even less.

The Oscillator

The oscillator is operated by a motor generator which runs off the ship's lighting circuit, and consumes only about 400-500 watts for the smaller type used for depths of 1000 fathoms or less. Hydrophones are immersed in sea water in special tanks secured to the inside of the ship's plating near the keel. The timing device is usually placed in the wheel house or at some convenient place where it can be readily consulted by the officer of the watch.

The United States Coast and Geodetic Survey has been cooperating with the Submarine Signal Corporation during the last two years in improving this apparatus and testing it under all kinds of conditions that are encountered in hydrographic surveying. Three such machines are now installed on surveying vessels and in the near future all survey ships will be equipped with this apparatus. The machines were used continuously during the last surveying season with excellent results. The Commanding Officer of one of the ships of the Survey reported that with the aid of his echo sounding machine he accomplished so much more hydrography than would have been possible without that apparatus that the machine paid for itself the first season—about 4 months.

During the recent cruise by the writer through the uncharted waters west of the Hawaiian Island the echo sounding machine was used continuously in navigating the ship among the shoals and reefs that abound in these waters. Soundings were taken at intervals of ten minutes in deep water and at more frequent intervals as the depths decreased; one minute soundings were taken over shallow banks.

By this means it was possible to cruise at full speed day and night through waters known to be dangerous but for which adequate charts are nonexistant. The risk was small since we knew at all times exactly the depth under the ship and how rapidly the depth was changing. About three thousand soundings were taken and recorded along a track of approximately two thousand miles and all of these soundings were taken without slowing down or in any way interfering with the navigation or progress of the ship.

A merchant ship equipped with this apparatus should be able to make port during thick weather or avoid dangerous shoals, by soundings alone. Given an adequate chart, the master should be able to spot his position at any time by a comparison of a set of echo soundings with the charted depths and lay his course with at least as much confidence as from astronomic sights.

This development is one which should be watched closely.

Form, Proportions, and Ship Resistance

In a paper dealing with essential aspects of form and proportions as affecting merchant ship resistance and a method of approximating e.hp., read recently by A. L. Ayre, before the North East Coast Institution of Engineers and Shipbuilders, Newcastle, England, the two principal subjects indicated in the title are necessarily interwoven rather than treated in distinct parts. That which concerns form and proportions is considered of fundamental importance in any review of the subject of ship resistance, and regardless of the methods which may be adopted to determine its amount. That concerning a new method of approximating e.hp. justifiably eliminates the necessity of treating separately the frictional and residuary resistances in the case of full-sized ships.

The desirability of using $\frac{V}{\sqrt{L}}$ as the speed scale is referred to. For the resistance scale, a new constant, C_2, is proposed; it is used in the simple and brief formula:—

$$\frac{\Delta^{.64} \times V^3}{C_2} = \text{e.hp.}$$

It applies to full-sized ships, say 100 ft. in length and beyond—not over the range from model to ship — and for identical forms, although differing substantially in size, is *constant* at "corresponding" speeds. Simple arithmetical tests, by means of comparison with existing methods, as to the reliability of the formula, are given. The importance of the principal factors of form, and proportions of dimensions, is dealt with, and attention is drawn to five factors, in these respects, which principally determine the amount of resistance. Reference is made to the necessity for the rational use of model-experiment data, and the desirability of adopting standard bases for form and proportions for the present purpose, and such are proposed. Values of the constant C_2 are given corresponding to the adopted standards of form and proportions, and supplemented with correctional values for differences between the standards and those which may apply to a particular vessel.

Review

The Port of Porto Rico

A report on the ports of Porto Rico has been issued by the Board of Engineers for Rivers and Harbors of the United States War Department, in cooperation with the United States Shipping Board. This volume is No. 21 of a series on the ports of the United States, but it is only the seventeenth report to be distributed. Nos. 12, 15 and 18 have not yet been completed for distribution. Copies of the report may be obtained for 40 cents each upon application to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Airless Tug D. A. Diesel

(*Continued from page* 51)

a common forged steel body. The operating gear is very similar to the fuel pump plunger operating gear, i.e., a rocker mounted as an eccentric shaft capable of angular movement and operated by a cam and roller. Angular movement of the eccentric shaft causes the starting valve to be put quickly into or out of operation in either ahead or astern direction.

Separate ahead and astern cams are provided for both fuel pump and starting air valves. When the eccentric shaft is in the stop position the rollers are lifted clear of the cams and the whole camshaft moves axially until requisite cam is under the roller. Rotation of the layshaft then puts first the starting air valves into operation together with the fuel pumps for the lower cylinders and then as the engine fires, further rotation puts the starting air valves out of action and the fuel pumps for the top cylinders in action. Reversing takes place by moving the camshaft laterally by means of a horizontal hand lever provided with locking gear. All control gear is of hand operated type.